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The 174th Street Arch under the Grand Boulevard and Concourse, Borough of The Bronx, New York City

By Jacob M. Friedland.*

The Grand Boulevard and Concourse is a parkway 182 ft. wide, extending from the southern end of Franz Sigel Park, at East 151st St., New York City, north to Mosholu Parkway, near Van Cortland Park. It is laid out on the crest of a practically unbroken ridge which separates the Jerome Ave. valley from the Webster Ave. valley.

The law which authorizes the Concourse provides for the construction of not more than fifteen "Transverse Roads" under it. These enable the crosstown trolley cars to cross the Concourse without endangering the fast north and south automobile traffic, and at the same time they eliminate some very steep grades for the general east and west traffic. In the typical Transverse Road, of which seven have been constructed so far, the inclined approaches to the Concourse are 35 ft. wide, and the transverse road has a 36-ft. roadway and two 4.5 sidewalks. A single row of columns in the center of the roadway carries a line of girders, which girders and the sidewalls, in turn, support transverse 24-in. I-beams with concrete jack-arches which carry the roadway above them.

The 174th St. Transverse Road differs entirely from the typical road described above. The Concourse at this point is so high above the adjacent streets that the inclined approaches were omitted. The road, therefore, simply permits 174th St. to run into Featherbed Lane, which leads, by way of Aqueduct Ave., to the Washington Bridge over the Harlem River. The underlying material being a compact limestone, it was decided to build a masonry (concrete) arch, which was more economical than a steel structure, and permitted a street 80 ft. wide without obstructions in the roadway.

Among the noteworthy peculiarities of this arch may be mentioned (1) the sharp skew; (2) the deep fill over the arch; (3) the design of the spandrel walls; and (4) the architectural treatment of the faces of the arch and of the spandrel walls.

Sharp Skew—The east face makes an angle of about 52.5° with the axis of 174th St. (instead of 90°), and the west face makes an angle of about 58.5° with it; so that while 174th St. is only 80 ft. wide, the span, measured along the east face, is 100.93 ft. (See Fig. 2.) The arch barrel, with a length of over 221 ft. along the center line of 174th St., is divided by expansion joints into six sections of 36.84 ft. each, in order to make sure that the arch would have an effective span of about 100 ft. Without these joints the arch would probably have acted as an arch with a span of 80 ft., while near the faces there would be overhanging ends in which the stresses are practically incomputable, and which would have been endangered by the extra weight of the spandrel walls and by the outward thrust at their foot.

Deep Fill—In order to pass the sewers on the Con-

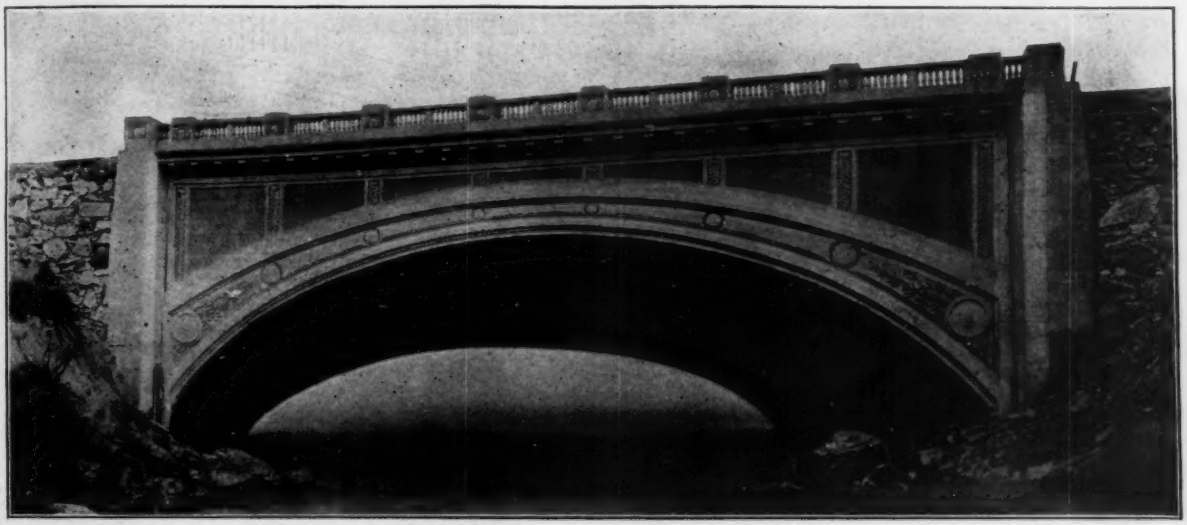


Fig. 1. Concrete Skew Arch Carrying the Grand Concourse over 174th St., Borough of the Bronx, New York City

*664 E. 170th St., New York City.

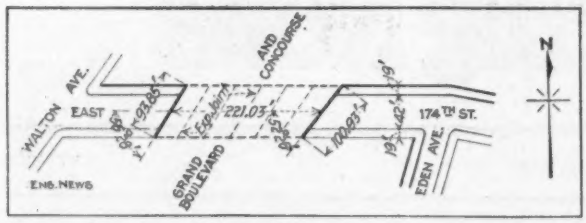


FIG. 2. PLAN OF 174TH ST. CROSSING OF THE GRAND BOULEVARD, THE BRONX, NEW YORK

enough for the extra load due to the spandrel walls, the balustrade, and the earth thrust.

SPANDREL WALLS—A spandrel wall acting as a retaining wall of the gravity type, or of the usual plain or buttressed reinforced types, with heel weighted down by earth backing, was not considered safe here. The intensity and the uncertain nature of the stresses near the faces, the downward slope of the top of the arch toward the face on account of the skew, and the fact that high compressive stresses, added to the outward thrust, might

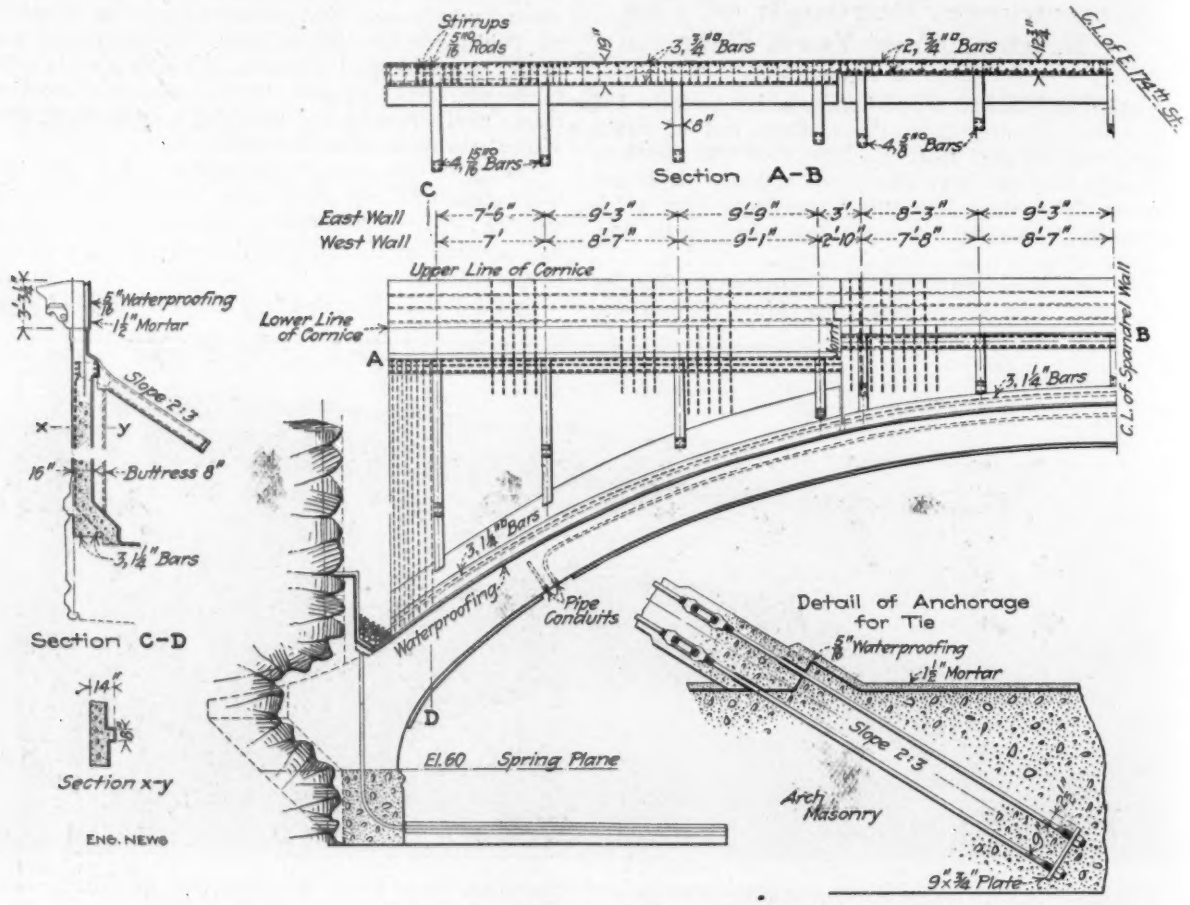
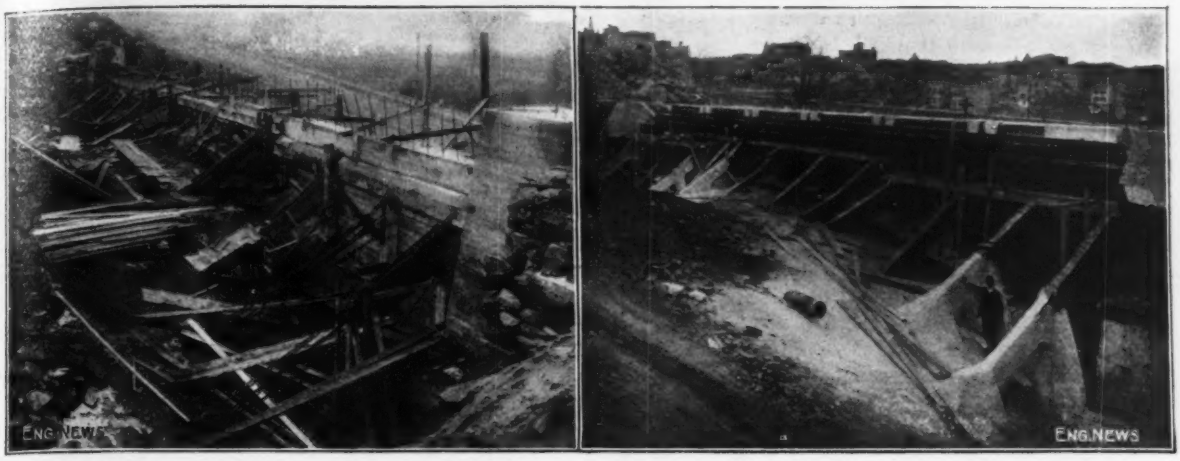


FIG. 3. DETAILS OF THE SPANDREL WALL

course across the arch, the fill over the crown had to be 9.5 ft. deep. While the heavy fill simplified the computations by reducing the disturbing effect of the live load unit stresses on the dead-load unit stresses, it required an arch with low haunches, and with correspondingly high retaining walls over them.

Excepting 2 ft. from either face, the arch is of plain concrete of a 1:2:4 mixture, in which the native stone was used. It has a span of 100 ft. and a rise of 22.4 ft. The crown is 2.85 ft. thick and the spring 8 ft., not counting 3 in. of extra thickness on the soffit to produce the paneled effect. Contraction and expansion effects, based on a drop in temperature of 60° F., produce extreme fiber stresses of 700 lb. per sq.in. compression, and negligible tension at the critical joint. For 2 ft. from either face, the arch is made 6 in. thicker and is reinforced with twelve 1.25-in. square bars to make it strong cause the architectural features of the face to spall off. All these considerations made it desirable to obviate high toe stresses under the wall, as well as outward thrusts on the face of the arch. Computations also showed that shrinkage and arch deflection would cause the wall to crack unless expansion joints were provided, both in the wall and between the wall and the arch extrados.

Fig. 3 shows the wall that satisfies the requirements. Below the cornice the wall is a reinforced-concrete slab from 10 to 16 in. thick, with vertical reinforcement. Nearly the entire earth pressure against it is transmitted to the horizontal beam, placed at a height slightly above the resultant of the earth pressure, so as to leave a very small outward thrust at the base. The horizontal beam in turn reacts against the inclined ties which are anchored back into the arch far enough from the face, or into ledge rock. These ties are in planes perpendicular to the face,



FIGS. 4-5. VIEWS SHOWING THE SPANDREL WALL DETAIL DURING AND AFTER CONSTRUCTION

and not parallel to 174th St., and for this reason some of them do not strike the arch barrel at all.

The vertical component of the stress in the inclined

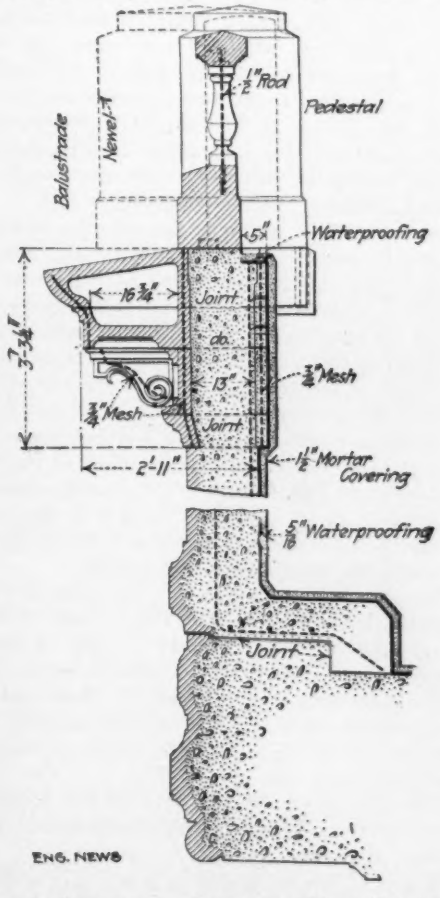


FIG. 6. DETAILS OF CORNICE, 174TH ST. ARCH, NEW YORK CITY

ties is taken up at the wall by concrete posts cast integral with the wall slab, and is distributed evenly over the 2-ft. width of face arch, which is thickened and specially reinforced to carry the additional load.

On top of the wall slab, and forming an integral part of the wall, rests the cornice, which is 3 ft. 3¼ in. high. (Fig. 6.) It consists of four courses of cast concrete blocks having cellular spaces directly over the wall slab, running clear through the four courses, and permitting the reinforcing bars from the slab beneath to pass through to the uppermost block. The cellular spaces were filled with concrete to key the whole firmly together. Enough reinforcement was provided to make the whole act as a reinforced-concrete beam, resisting the moment

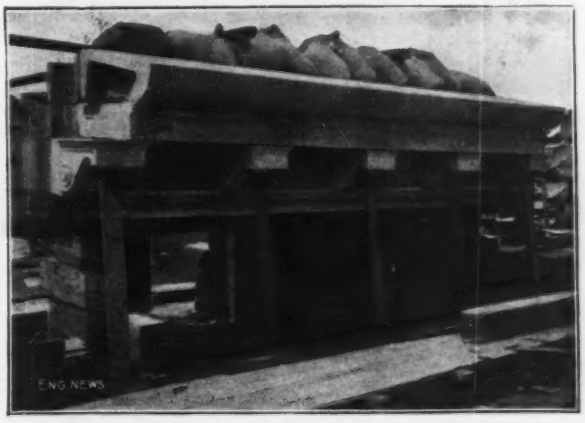


FIG. 7. CORNICE BLOCKS IN PLACE

due to the earth pressure behind, and to the overhang on the face.

ARCHITECTURAL TREATMENT—As shown by Fig. 1, the architectural treatment is elaborate. The balustrade and the cornice consist of cast concrete elements (Figs. 6-7), the balustrades having no less than eight different elements, and the cornice not less than five, not counting right- and left-hand elements and special blocks near the ends. The oblong foliated panels on the wall and the panels carrying the branches and the large end medallions are inset, and were anchored with dowels after the rest of the work had been completed and the face forms removed.

None of the face fillets corresponds to a line of the arch behind it, nor do the long foliated panels coincide

with the location of the ties which hold the wall. Yet so skillfully has the work been carried out that the free joint which separates the wall from the arch cannot be detected, while only parts of the vertical joints in the wall can be seen where they are not concealed by the foliated panels. The latter joints are carried clear through the cornice and balustrade.

Fig. 8 shows the arch centering. The specifications required it to be so smooth and rigid as not to leave any marks either of the wood, or of deflection or irregularity, on the completed arch. The centering was used three times, being lowered, shifted and wedged up twice.

To get the correct position of the many fillets, tablets, etc., on the face, the whole face was carefully plotted on stretched paper to a scale of 1 in. = 1 ft., and the coördinates of the several fillets and tablets scaled and reduced to a table of elevations. These were afterwards marked on the face forms, and the strips and tablet molds fastened to the backing board in accordance with these marks.

The fact that the face concrete, from 2 to 3 in. thick, is different from the backing concrete, and the thinness of the entire wall made it necessary to carry up the rear

FIG. 8. CENTERING FOR SKEW ARCH, 174TH ST. AND GRAND CONCOURSE, NEW YORK CITY

form just ahead of the concreting; so that, while the rear boards were being nailed up, the face concrete having the consistency of stiff mortar was deposited with trowels against the face forms, and right behind it was dumped the wall concrete. Considering the complications the results are remarkably satisfactory, and, unlike other works of the same nature, the actual face looks even better than the "picture."

SPECIFICATIONS—The following are abstracts from the specifications:

Class A concrete and reinforced concrete to consist of one part cement, two parts sand and four parts broken trap rock or limestone.

Face concrete to consist of one part white portland cement to three parts aggregate. Aggregates other than the sand shall be crushed stone of suitable size and color to produce the appearance of the finished sample.

Material of concrete for blocks, except for facing thereof, shall be in accordance with specifications for reinforced concrete.

Blocks shall be set by competent stone setters. Mortar shall be of the same materials and proportion as the faces of the blocks, and shall be spread on full beds. Face joints shall be raked out ¾ in. They shall then be filled with damp cement mortar similar in color to the face concrete, caulked hard and neatly finished with flat-faced calking chisel.

Panel ornamentation of the arch faces, and the foliated panel ornaments of the spandrel walls shall be cast separately, to fit recesses left for them in the concrete. Each piece shall be anchored with at least three anchors made either of aluminum, or of steel, hot galvanized all over. No part of these ornaments shall be thinner than 2 in. unless so shown on the detail drawings.

PERSONNEL—The arch was designed in the Bureau of Design of the Borough President's office, Borough of The Bronx, Richard H. Gillespie, Chief Engineer, and Charles Gartensteig, Engineer of Design. F. F. McDowell was Assistant Engineer in charge of construction. Handy Bros. were the contractors, and the concrete work was carried out by the Londino Construction Co., as subcontractors, to whom most of the credit is due for the success of the work.

Scoop Car for Handling Railway Slides

A special car has been designed for clearing railway track of material brought down by landslides or by the caving of a tunnel roof. In such cases the use of a steam shovel may be impracticable, due to the difficulty or impossibility of getting cars within its reach to receive the material excavated, while in many cases the slide may contain large masses of rock difficult to handle. The scoop car is forced ahead into the material till the scoop is full, and the car is then hauled rapidly to some convenient point for dumping. These cars are in use on the Norfolk & Western R.R. and a few other roads, and one of them is shown in the accompanying cuts.

The car is 40 ft. long over the end sills, or 54 ft. 8 in. over all; it is equipped with a 20-ton crane mounted over the center of the front truck, and having a fixed reach of 12 ft. A double-drum hoisting engine with cylinders 8¼x10 in. operates the 1-in. hoisting cable and the ¾-in. swinging cable, the latter passing around a bull-ring at the foot of the mast. There is a vertical boiler 8x3½ ft., with the necessary coal space and water tanks. To the hoisting block is attached a swing beam having a chain at each end. The scoop is about 12 ft. long, 7 ft. 8 in. wide and 3 ft. 4 in. deep inside, with a nominal capacity of 10 cu.yd., and it is fitted with heavy teeth on the edge. The car and its machinery weigh about 90,500 lb., which the scoop increases by 16,900 lb.

When excavating, the front of the scoop is attached to the chain hooks and its rear end is held by a pin and backed against a heavy bumper in front of the car, the bumper being supported by inclined braces from the sills. When the scoop is loaded, its front end is raised clear, and the car is run out. At the dumping point, the scoop is lowered upon the rails, with a timber or metal block under one side (as in Fig. 2). The chains are then detached from the end and hitched to lugs on the bottom of one side, so that the scoop can be tilted and emptied, as in Fig. 1.

The use of this car is said to result in considerable saving of time and expense by reason of its being able to handle quantities of loose rocks much too large to be removed by hand. The following example of the work done is from a report by H. C. Weller, Superintendent of the General Western Division of the N. & W. R.R.

We have had occasion to use the scoop car for the purpose

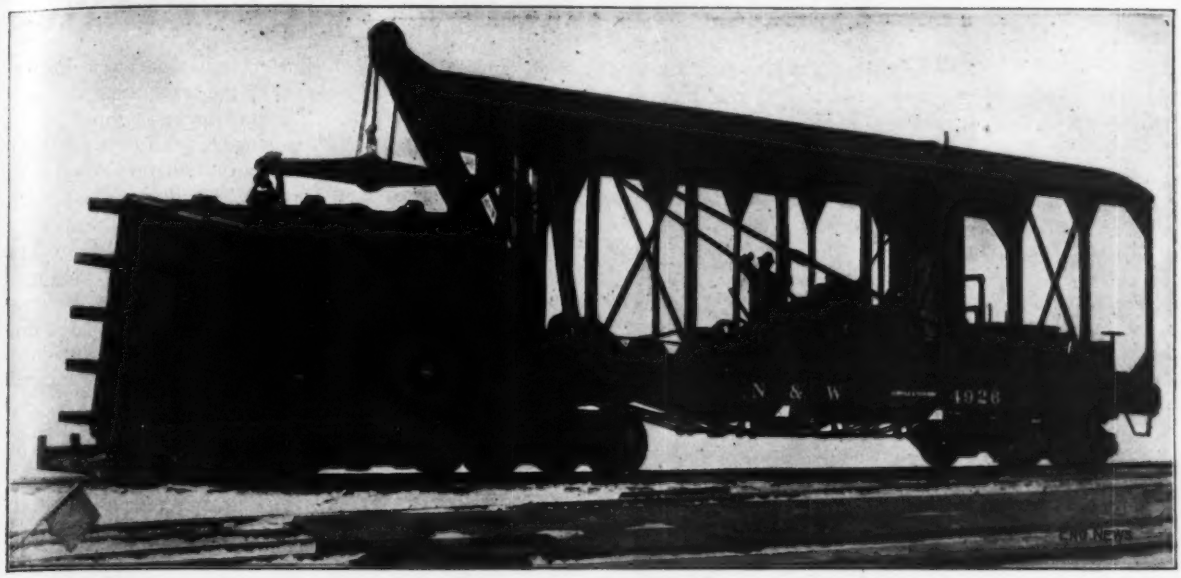


FIG. 1. SCOOP CAR FOR CLEARING SLIDES; NORFOLK & WESTERN R.R.
(The 10-yd. scoop is shown in the dumped position.)

of moving slides on new westbound main track east of Sycamore. We had a slide at that point approximately 110 ft. in length and 5 ft. deep, or a total of approximately 800 cu.yd. of material to move. It required 10 hr. with the scoop car to move this and convey it from 100 to 150 ft. from the point of the slide. Our labor cost for handling the above quantity of material, which consisted of dirt and rock, amounted to $182, including work-train cost, etc., which is 22.7c. per cu.yd. On occasions when it has been necessary to use the scoop car for handling slides it has proved very satisfactory.

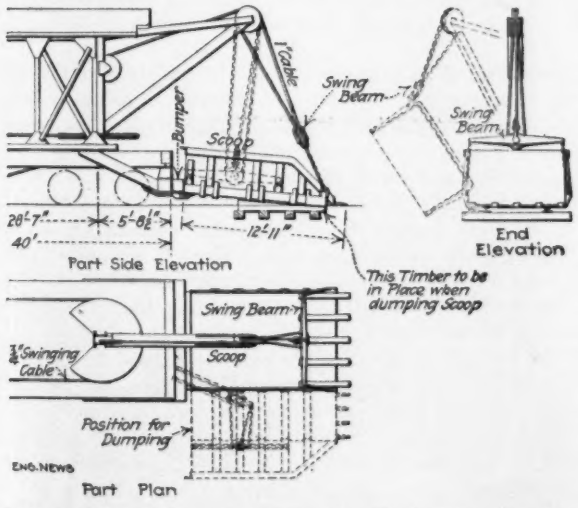


FIG. 2. FRONT END OF SCOOP CAR, SHOWING ATTACHMENTS WHEN EXCAVATING AND DUMPING

This scoop car has been designed and patented by L. E. Johnson, President of the Norfolk & Western R.R., at Roanoke, Va., and we are indebted to him for photographs and other information.

Preventing Escape of Natural Gas While Drilling for gas or oil is a subject given considerable study by the United States Bureau of Mines, and the result published in Technical Paper 68, dated 1914. Practically all wells are drilled under contract. The contracts are usually lax, to allow for the variable conditions. Drilling contractors are apt to be inclined to disregard the interests of the owner, and to devote their energy to "making hole," i.e., to drilling to a maximum depth in the shortest time and with the least cost. The suspension of work to examine the tightness of casing, or to case off water or gas, is not viewed favorably by the contractor.

The investigation of the Bureau was conducted in the Cushing field, in Creek County, Oklahoma. The method of drilling here is similar to that employed in all Eastern and Northern oilfields, and is called the "dry-hole" method of cable-tool drilling, as the hole is drilled with practically all water cased out. Only enough water is used to keep the drillings slushed out, so that the drill bit strikes the rock at the bottom and the bailer can pick up the drillings and clean the hole. In the Cushing field, the main producing sand, both of oil and gas, is the "Wheeler sand," at 2200 ft. below the surface. The average time required to drill a well to this sand is about 50 days. The hole is usually started 18 in. in diameter; 16-in. casing is set to a depth of 20 to 60 ft., from which point the hole is carried down with a diameter of 16 in. to a depth of 500 to 600 ft., where 12½-in. casing is set. It is necessary to set 10-in. casing at about 800 ft., and 8-in. casing at a depth of about 1200 ft. From 1200 ft. is is usually possible to drill open holes to the top of the Wheeler sand, when 6⅝-in. casing is placed. With this method, the gas waste runs into millions of cu.ft. per day. To give instances, on Apr. 10, 1913, a well was drilled into the Wheeler sand and allowed to go wild for four days, i.e., the drillers left the well without sealing it. The gas wasted daily through an 8-in. open hole was 37,000,000 cu.ft. Its roar could be heard two miles away. This well was shut off on Apr. 17, after some 250,000,000 cu.ft. of gas had been wasted. Nearby, at about the same time, gas was struck at about 520 ft. in a 10-in. hole, and 30,000,000 cu.ft. of gas escaped daily for several days. Other instances are cited, the gas waste in several days. Other instances are cited, the gas waste in some reaching 40,000,000 cu.ft. per day.

The method for conserving gas recommended by the Bureau of Mines is known as the mud-laden fluid method. For purposes of demonstration, a well which had been drilled to a depth of 2140 ft., was filled with mud-laden water and allowed to stand thus for three days, when drilling was resumed. Gas which had been escaping from the well before the introduction of the fluid mud was successfully excluded from the bore-hole. Demonstrations show that the precautions necessary to prevent gas leakage are as follows: (1) Seal gas-bearing stratum as it is encountered, by drilling with the holes full of mud-laden fluid; (2) Set each string of casing with a secure and watertight base, using a long shoe or packer to insure tightness; (3) when casing through a gas-bearing stratum, keep the space between the casing and wall full of mud fluid; (4) place a gate valve on top of the inner string of casing before drilling into any gas-bearing stratum.

A Low-Head Water-Power Plant

SYNOPSIS—At the Coon Rapids hydro-electric plant on the Mississippi River, six miles above Minneapolis, 15,000 hp. will be developed with only 17½-ft. head. The dam is supported on piles with steel sheet-pile cut-off walls beneath. The water level is regulated by large Taintor gates on the dam crest. Vertical turbines are used of 2100 hp., carried on roller bearings at the top of the shaft. Steel-framed forms were used for the dam.

The hydro-electric power plant now under construction on the Mississippi River, at Coon Rapids, six miles north of the city limits of Minneapolis, is of interest on account of the low head to be developed and also on account of the manner in which the power is to be used. The average head is about 17½ ft., and with full flow there will be a development of 15,000 hp. (seven units). There is no storage capacity, however, and at low stages of the river, the flow will be sufficient to develop only about 4400 hp.

Obviously, this great variation in power capacity would not be satisfactory for an independent plant, but this plant will be an auxiliary to the larger hydro-electric plant (of 25,000 hp.) at Taylor's Falls, on the St. Croix River, which is owned by the same interests and which supplies current for lighting, traction and general power purposes in both Minneapolis and St. Paul. At present, a steam plant of 16,000 hp. is held in reserve at Minneapolis, with fires banked, to take care of peak loads. The Coon Rapids plant will provide for these loads and will enable the steam plant to be shut down, and kept as a reserve for use only when the river is low or in case of any failure at the water-power plant.

In December, 1910, Congress granted the Great Northern Development Co. permission to build a dam at the Coon Creek Rapids, to develop water power under a nominal head of 18 ft., and the general plans were approved by the War Department in September, 1911. Nothing was accomplished in regard to financing the project, however, and only enough construction work was done to comply with the requirements of the franchise.

In December, 1912, the franchise and property were transferred to R. J. Graf, as trustee, pending the organization of the Northern Mississippi River Power Co., which was completed in March, 1913. Revised plans were approved by the War Department in December, 1912. The franchise required the dam to be completed by Jan. 12, 1914, so that prompt action was necessary. As soon as the property was in the hands of the trustee, a survey party was organized to check the land lines and the flow line of the reservoir, and a superintendent was appointed to organize a construction force and establish a camp. The dam was completed early in January, 1914, and probably the first generator units will be in operation by September.

The general character of the plant is shown by the plan, Fig. 1. There is an island in the river at the site of the dam, and as the left channel is narrower and deeper than the others it was decided to place the power house across this channel, and to build a spillway dam across the wider and shallower channel, the water level being regulated by a row of Taintor gates along the top of the dam, raising the normal water level 7½ ft. above the spillway level. This arrangement is similar to that at the Keokuk Dam, but in the latter case vertically sliding gates are used. The spillway has a discharge capacity of 80,000 cu.ft. per sec.

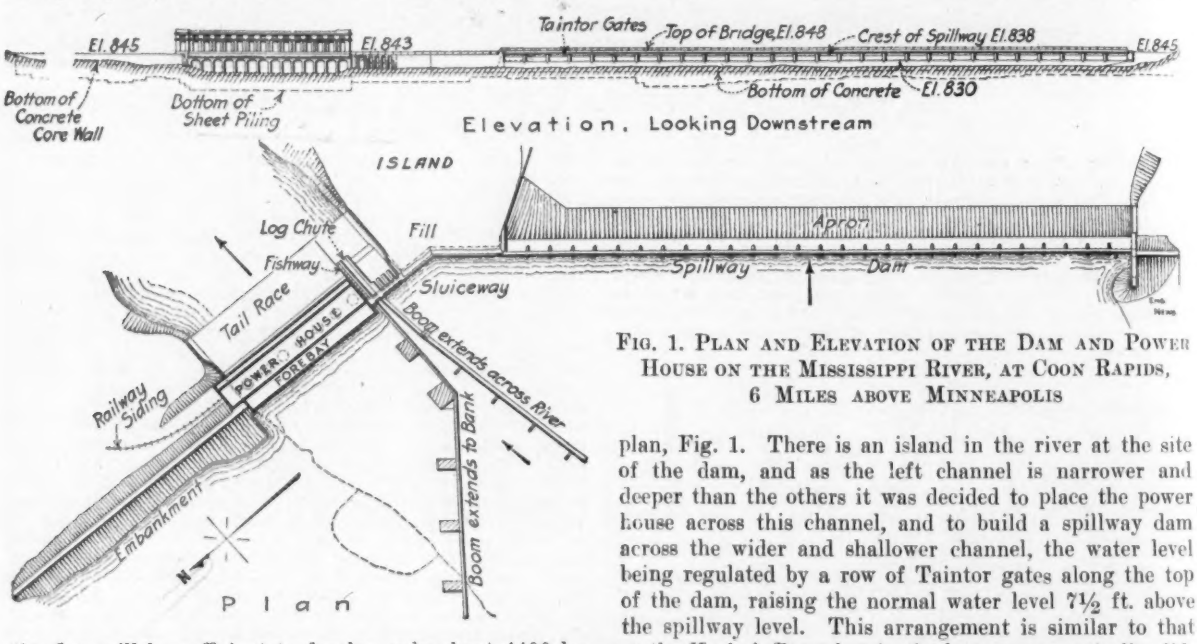


FIG. 1. PLAN AND ELEVATION OF THE DAM AND POWER HOUSE ON THE MISSISSIPPI RIVER, AT COON RAPIDS, 6 MILES ABOVE MINNEAPOLIS

A concrete retaining-dam extends across the head of the island from the end of the spillway dam, and between this and the power house are located a fishway, a log chute and four sluice gates. An earth embankment extends from the power house to the high ground on the north bank.

With this arrangement of the power house and spillway, no flood water will be passed through the tail race, and the effective head will be reduced during flood stage only by the backwater from the foot of the island. The spillway dam has a length of about 1000 ft.; the retaining-dam at the head of the island, 170 ft.; the sluices, log chute and fishway, 62 ft.; the power house, 255 ft.; and the embankment 570 ft., making a total length of 2070 ft.

The entire plant was designed by H. M. Byllesby & Co., consulting engineers, of Chicago; Otto E. Osthoff, Chief Engineer, and W. R. Thompson, Manager of En-

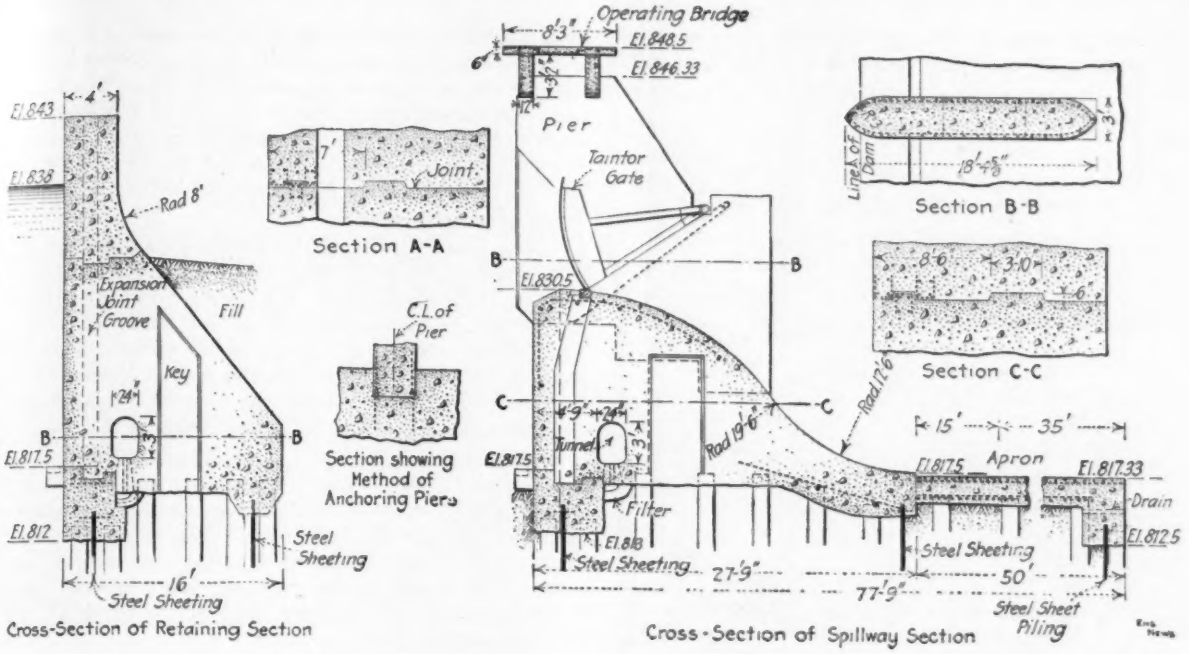
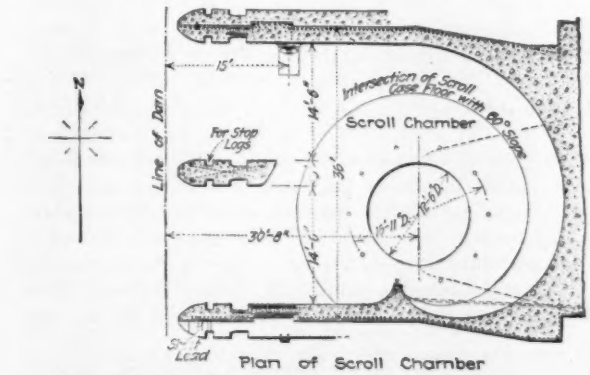


FIG. 2. CROSS-SECTIONS OF DAM, SHOWING THE SPILLWAY SECTION AND RETAINING SECTION



gineering and Construction. It was built by this company's construction force. The design and construction were under the direction of J. W. Link, Hydraulic Engineer; W. T. Walker was Superintendent of Construction, and W. B. Saunders, Resident Engineer.

SPILLWAY DAM

The main dam is built on a deep bed of glacial drift. The Great Northern Development Co. in its preliminary work had made a line of wash borings across the river, approximately on the line of the dam, and other borings above and below the line. These indicated that rock was at too great a depth (not less than 150 ft.) to be reached by the foundations. The Byllesby Co. had additional

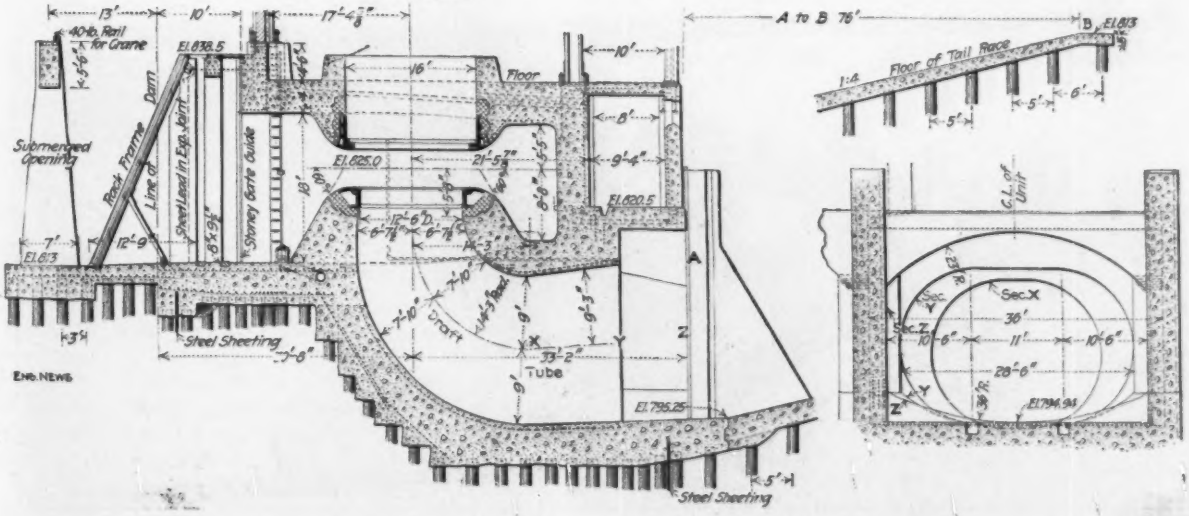


FIG. 3. SECTION THROUGH LOWER PART OF POWER HOUSE; SHOWING THE INTAKE, SCROLL CHAMBER AND DRAFT TUBE OF ONE UNIT

test borings made by driving 1-in. pipe, the pipe being pulled up after each penetration of about 2 ft. to 3 ft. and the inclosed material removed and preserved. This method gave more definite results than those of the wash borings, but still was not entirely satisfactory.

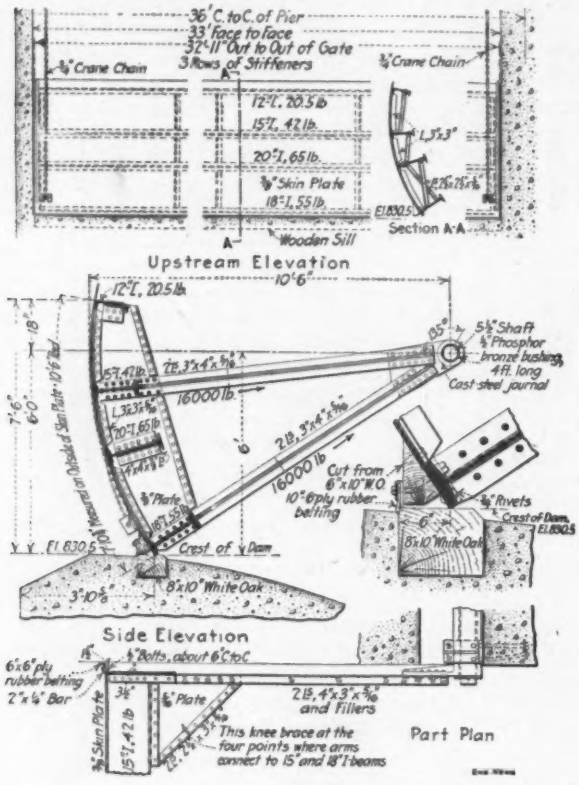

36' C. to C. of Pier
33' face to face
32'-11" Out to Out of Gate
3 Rows of Stiffeners
Upstream Elevation
Section A-A
Wooden Sill
Side Elevation
Part Plan
Crest of Dam
Cut from 6"x10" W.O.
10"-6ply rubber belting
8"x10" White Oak
This knee brace at the four points where arms connect to 15" and 18" I beams

FIG. 4. TAINTOR GATES OF THE COON RAPIDS DAM, NEAR MINNEAPOLIS

The work was done with well-drilling outfits. The pipe drill was fitted with a collar near the upper end to receive the blow from the hammer, the latter having a hole through the center so as to slide on the pipe. The hammer rope passed over a sheave on top of the leads or tower and down to a niggerhead or drum on the engine. The drill runner alternately slackened and tightened the rope on the drum to give the required raising and dropping of the hammer.

The spillway dam is of the section shown in Fig. 2, with a base width of 27 ft. 9 in. and a height of about 12 ft. to the spillway crest. Within it is formed a drainage conduit, with openings in the bottom to a gravel-filled trench or filter, so that any water working beneath the heel can escape without causing upward pressure on the base of the dam. Below the dam is a reinforced-concrete apron 50 ft. wide to prevent scour at the toe.

Along the dam are piers 3 ft. thick, and 36 ft. apart, carrying two lines of reinforced-concrete girders with a deck 8 ft. 3 in. wide, upon which are mounted the hoists for operating the Taintor gates. The boxes for the shafts of these gates are carried in the rear end of the piers. The section of the retaining dam between the power house and the spillway dam, across the head of the island, is also shown in Fig. 2.

The dam is carried on foundation piles, driven to varying depths, and until the penetration indicated a safe bearing value of ten tons per pile. To provide a cutoff against flow of water beneath the dam, there are two lines of steel sheet piling, driven to penetrate at least 5 ft. into material which, from the borings, was assumed to be impervious and which varied in depth below the river bed from about 2 ft. at the south end of the dam to about 25 ft. at other points. A third row is carried under the toe of the apron but this is only 8 ft. deep, being intended to prevent scour beneath the apron by back-wash. For about 200 ft. at the south end where compact material rises to the surface, a trench was cut in this and a concrete cutoff wall built. The power house also has pile foundations, driven to refusal in the com-

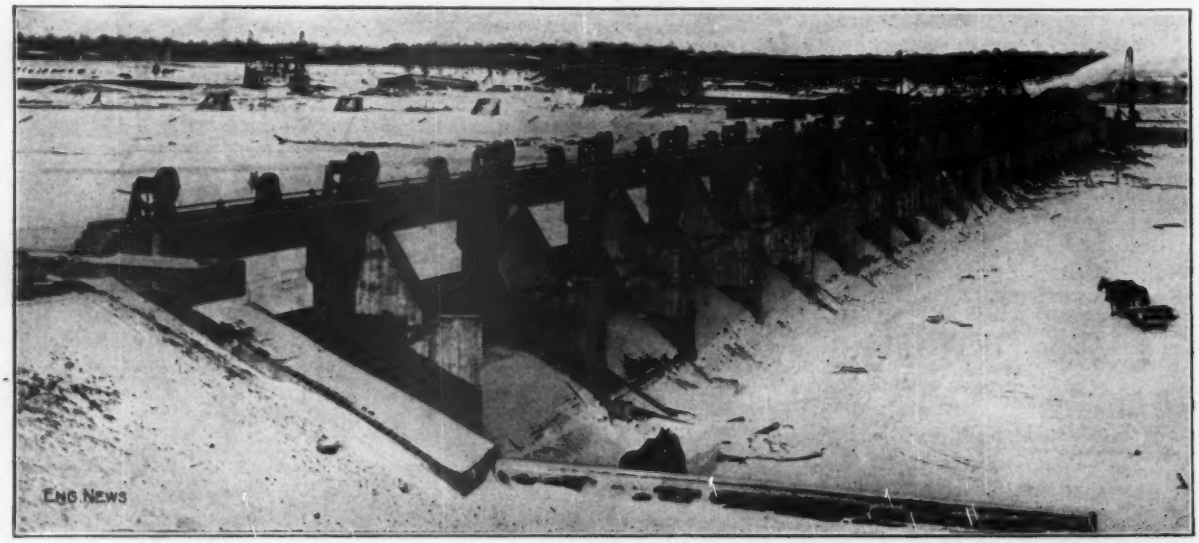


FIG. 5. THE SPILLWAY SECTION OF THE COON RAPIDS DAM ON THE MISSISSIPPI RIVER, ABOVE MINNEAPOLIS

(The spillway section has 28 openings 33 ft. wide, with Taintor gates above the crest, the gates being operated from the concrete deck or bridge. View looking north from the downstream side. The power house is at the farther end, where the derricks are at work.)

pact material, while lines of steel sheeting form the cutoff.

Power House

Fig. 3 is a section through the lower portion of the power house. In the forebay is the wall of the intake, with submerged openings to the screen chamber, which contains the inclined trash racks and has grooves for Stoney gates to close the inlets to the turbines when necessary. The gates will be operated from a hoist on a gantry crane spanning the chamber, one end of the crane-girder having wheels riding on an elevated runway along the wall of the power house, while the other end rests on a leg with wheels riding on a rail laid along the forebay wall.

From the inlet the water enters the scroll chamber, and after passing through the turbine is discharged through the draft-tube, which enlarges from a circular opening 12 ft. 6 in. diameter beneath the turbine to an oval opening 32x23 ft. in the rear wall. This discharges the water into the tail race, which has an inclined floor of concrete on a slope of 1 on 4, rising from elev. 795 (the bottom of the discharge opening) to elev. 813, which is the level of the river bed.

There will be seven vertical-shaft turbines of 2100 hp. each, five of which are to be installed at present. The shafts are suspended from roller bearings above the generators.

Gates

The 28 Taintor gates along the top of the spillway dam are 32 ft. 11 in. long on the face and 7 ft. 6 in. high, with a face radius of 10 ft. 6 in., as shown in Fig. 4. Heavy vertical girders are connected by I-beams to which the faceplates are riveted, and the construction is sufficiently stiff to enable cross-bracing to be eliminated. Each gate weighs about 6½ tons, and is operated by a pair of chains passing over drums mounted on the concrete deck or bridge and arranged for either hand or motor operation. Fig. 5 shows the completed spillway with dam gates in place.

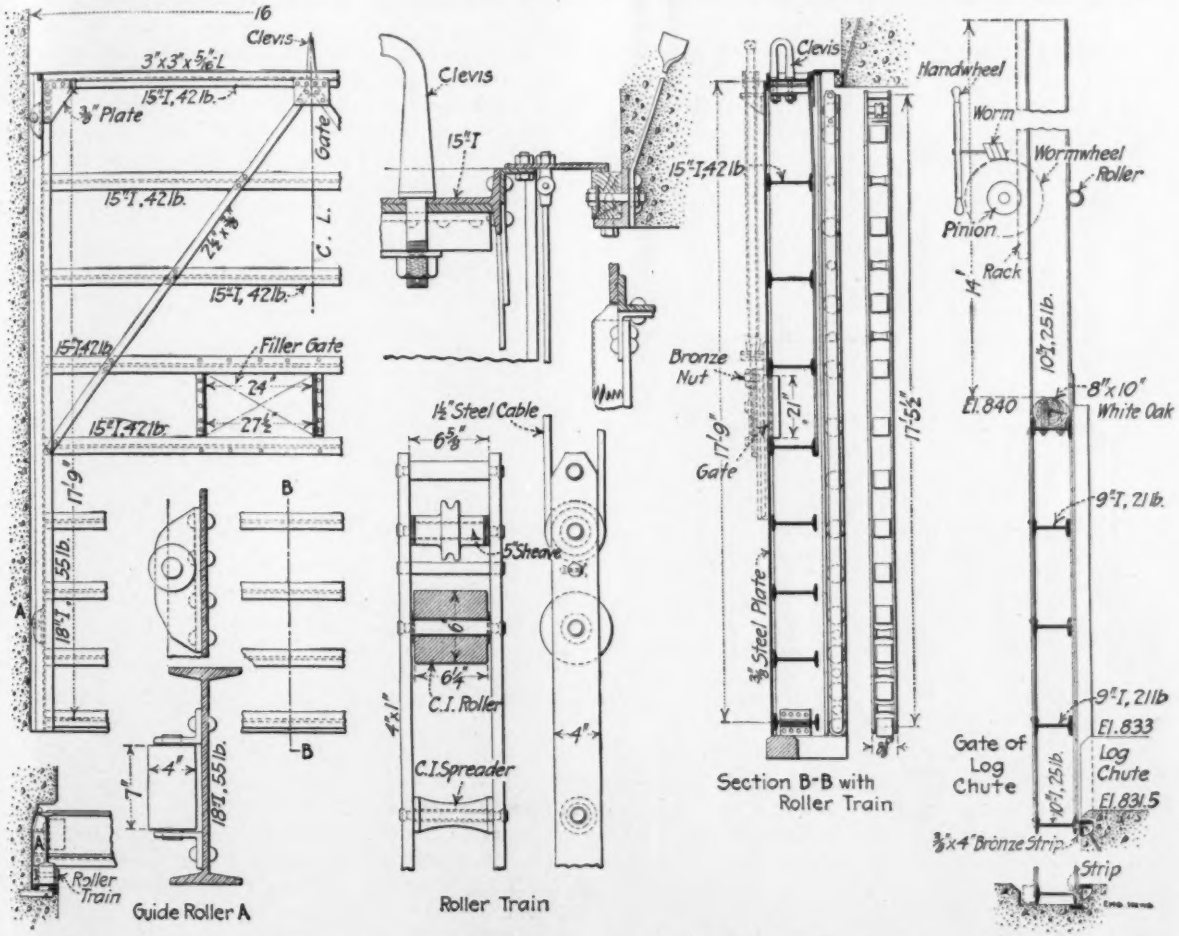


Fig. 6. Stoney Gates for the Power House Intakes, and Gate for the Log Chute; Coon Rapids Dam

When closed, the edge of the gate rests on an oak sill on the crest of the dam, and as such sills invariably warp to some extent, a water-tight joint is made by a doubled strip of rubber belting, which is attached to a timber on the face of the gate and projects below it so as to lie against the beveled corner of the sill. The ½-in. clearance at each end of the gate is also sealed with a rubber strip riding against the face of the pier, as shown.

The Stoney gates for the intakes have a framing of 18 in. vertical and 15 in. horizontal I-beams, with ⅜-in. steel plating on the upstream side, Fig. 6. At each

end is a train of rollers riding against a guide in the groove in the masonry. These gates are 15 ft. 2 in. wide (for 14½-ft. openings) and 17 ft. 9 in. high, weighing about 8 tons each. In the center of each is a filler gate 24x21 in., having threaded lugs engaging with vertical operating screws. On the top of each gate is a clevis loop, for the hook of the operating gantry crane.

The four sluice gates are 6 ft. 5½ in. wide and 11 ft. 9 in. high, weighing about 1½ tons each. Each is built of two 8-in. vertical I-beams, with horizontal I-beams between them and with plating on the upstream face. The gate has contact plates of bronze sliding against cast-iron guides in the masonry and has a vertical stem with threaded upper end passing through a revolving nut driven by a hand-operated bevel gear. Fig. 7 shows a section through the sluices. The Stoney gates and sluice-gates close against wood sills when lowered. The sluice gate for the log chute is of similar construction, 10 ft. wide and 9 ft. high, but moves downward instead of upward in opening. It is operated by a rack and pinion at each end, the shaft being driven by a worm gear and hand wheel.

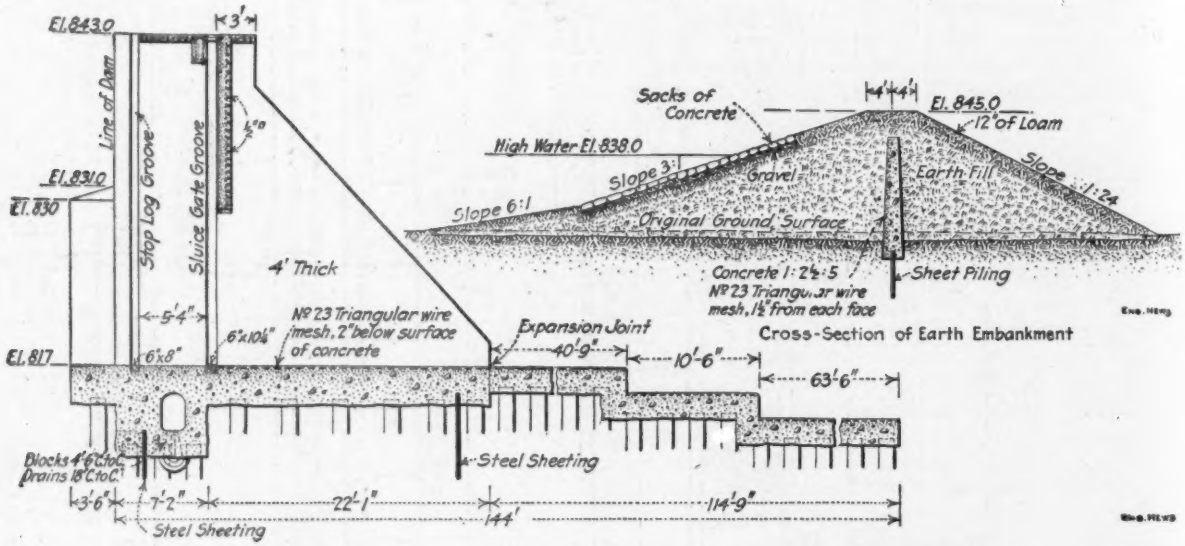


FIG. 7. CROSS-SECTION THROUGH SLUICES AND THROUGH EARTH EMBANKMENT

AUXILIARY WORKS

The log chute is 10 ft. wide, and the fishway is of the type prescribed by the U. S. Fish Commission. The embankment beyond at the north end of the power house has a concrete core wall, with a line of steel sheet piling beneath it. The slope of the embankment on the water side is paved with sacks of concrete laid on 6 in. of broken stone or gravel, as shown in Fig. 7.

There is a considerable amount of logging on the river, and special means are taken to keep the logs away from the forebay and spillway and to guide them to the log chute for passing the dam. Along the north shore and extending across the forebay is a heavy timber boom attached to cribs and forming one side of the approach to the chute. Another floating boom extends from the opposite side of the chute in a diagonal line across the river. The sections of this boom are anchored by chains to pairs of piles having the heads cut off below the water line.

CONSTRUCTION

The Great Northern Ry. and Northern Pacific Ry. are about a mile from the site, and within about half a mile are a public highway and the Minnesota & Northern Ry. This latter is an interurban line to Anoka, operated by gasoline motor cars and freight locomotives.* This line was used for bringing in materials, a spur being built which will be retained permanently. As the construction of the spur was delayed by very cold weather, large quantities of lumber, building materials, and pipe for the water and sewerage systems of the construction camp were hauled by teams and motor trucks from Minneapolis, a distance of 10 or 12 miles. The snow was not deep, and had packed so hard that the roads were good and heavy loads were handled without difficulty.

CAMP—The camp was located on high sandy ground and in a grove of oak trees at the north side of the river. It accommodated a force of about 800 men, besides many women and children. There were about 13 cottages for the accommodation of as many families, besides stores, etc. These were laid out on streets, and provided with water, sewerage (outdoor closets) and electric light. They were frame structures, covered with heavy roofing paper, and were well separated so as to reduce the fire risk. During severe winter weather, the bunk houses were heated by hot air furnaces. Other buildings had stoves.

All were one-story buildings, with the exception of the store, the hospital, the superintendent's office, and the bunk houses for the engineers and foremen. A school was provided for the children, and this was used also for moving-picture shows and other entertainments. The water (for domestic and fire purposes) was obtained from an artesian well. The sewage was delivered to an Imhoff tank and the effluent treated by the hypochlorite process.

The spur track from the interurban railway divided into two lines, one being a permanent line which enters

*"Engineering News," Oct. 16, 1913.

the power house and will serve for handling machinery, etc. The other was a temporary line at a higher elevation and extending on a trestle over the sand and stone bins of the concrete plant, so that these materials could be dumped directly into the bins. From these, it was raised by dump cars on a cable incline for delivery to the mixers. The two 1½-yd. mixers (driven by electric motors) discharged the concrete into 1-yd. dump cars on a narrow-gage track carried across the river on a trestle inside the coffer-dam.

Fig. 8 shows the trestle and construction track, with two inclined chutes for connecting the draft tubes. At the right is the higher trestle for the material track. the light locomotives and concrete cars, and the tracks were connected at frequent intervals by crossovers to facilitate operations. The plant was capable of mixing and placing 1000 cu.yd. of concrete per 24 hr. if necessary. The best records were 516 yd. in a 10-hr. shift, 1006 yd. in 20 working hours, and 72 yd. in one hour.

The concrete was discharged from the two 1½-yd. mixers into steel dump cars of 1-yd. capacity. These were hauled by light locomotives on the construction trestle inside the coffer-dam, the cars being dumped sideways at inclined chutes, as shown in Figs. 9 and 10. These chutes generally delivered the concrete into place, but for the apron of the spillway they delivered it into hoppers

FIG. 8. CONCRETING THE DRAFT TUBES OF THE POWER HOUSE AT THE COON RAPIDS DAM

(The concrete cars are run out on the longer trestle and dumped at hoppers on the inclined chutes. The shorter and higher trestle carries the material track, and has the storage bins beneath it. The draft tubes are 12½ ft. diameter at the upper end and 32x23 ft. at the outlet.)

Fig. 9 shows the work in the first portion of the coffer-dam. Two of the sections of the dam are completed and stripped, and a third is being concreted. The apron also is shown. The grooves in the upper face of the dam are for the piers. The trestle is at the right (upstream side).

This trestle carried three tracks. On the side next to the dam was a standard-gage track on which ran a locomotive crane (Fig. 8) for handling the form work, depositing concrete, setting Taintor gates, etc. Between the rails was laid a third rail to form a track of 3-ft. gage, and another track of 3-ft. gage was laid on the upstream side of the trestle. On these two tracks operated for supplying wheeled carts of 6½ cu.ft. capacity. The trestle track was a little above the level of the top of the dam, and for the upper part of the work the concrete was delivered in dump buckets (on flat cars) which were hoisted by a locomotive crane and dumped into the forms. This crane was used also to handle the forms and other material.

The concrete was mixed 1:2:4 for reinforced work, 1:3:5 for mass work, and 1:2:4 for the floor. All reinforcement was of square twisted bars. A good grade of sand was found adjacent to the work. The stone was crusher-run limestone, hauled from Minneapolis.

The cement store had a capacity of about 7000 barrels. The receiving track was on the outside, and the track for taking cement to the mixers on the inside but at the opposite side of the house, thus facilitating the taking of the cement from the storage space in the order in which it was received.

All the machines in the carpenter shop and blacksmith shop, as well as all pumps, etc., were driven by electric motors. As the current generated at this plant is to be sold in Minneapolis, the transmission line was built first (with one circuit of copper cable), in order to get current from the Minneapolis plant for use at the camp and on the construction work.

The construction of the dam was done in two sections, inclosed within timber coffer-dams, consisting of a row of piles 8 ft. apart with waling timbers and a single line of triple-lap sheeting. A bank of earth was deposited against the outside of the sheeting to make it waterproof. For the power-house work, in the deeper channel of the river, the coffer-dam was of stone-filled cribs, held in place by piles.

The deep excavations for the draft tubes extended some 25 ft. below the bed of the river. For the first four tubes the excavation was carried on while the sheeting was being driven and braced, and then the foundation piles were driven. The vibration due to the pile driving, however, caused such pressure and movement of the material that the bracing was distorted and broken and it was difficult to hold the sheeting in place. In fact, it became necessary to replace some of the 12x12-in. timbers with pairs of 15-in. I-beams.

As a result of this experience, for the other three draft tubes the steel sheeting was first driven, and then the foundation piles, these piles being put down to the required elevation by means of followers. When all this was completed, the space to be excavated was inclosed by wood sheeting driven to the full depth, and the bracing was placed as the excavation progressed.

Forms with steel ribs were used for the whole of the dam and Fig. 11 shows the design of these forms, which were in lengths of 54 ft. 8 in. The lagging was of wood, 4 in. thick, held to the ribs by light clamps as shown at A in Fig. 11. To resist the upward pressure of the concrete

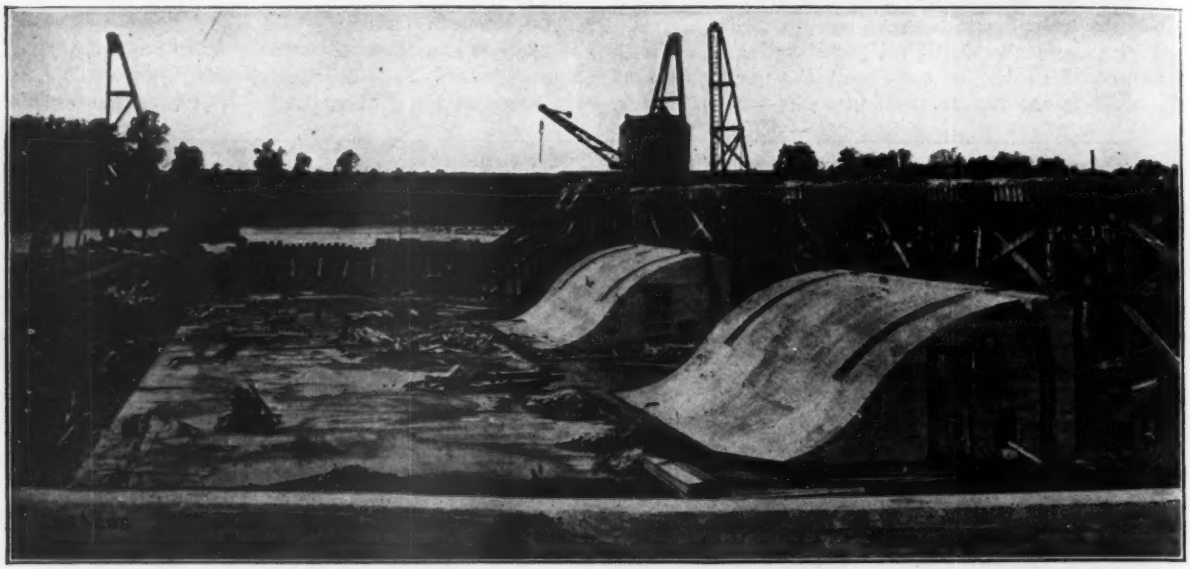


FIG. 9. FIRST PORTION OF SPILLWAY DAM COMPLETED WITHIN THE COFFER-DAM

(The construction track and concreting track are on the trestle at the right. The tunnel in the dam is a relief conduit, with overhead drains through the floor to permit the escape of any water under the dam.)

deposited beneath the lagging, the forms were anchored by rods secured to the foundation piles. The upright posts of the forms were seated in pockets in a concrete shelf along the face of the toe-wall. The piers were built after the dam proper. Fig. 10 shows the forms in place and concrete being deposited.

Four 54-ft. openings in the spillway dam were left to provide ample waterway while the work was being done in the coffer-dam at the power house. These were floored

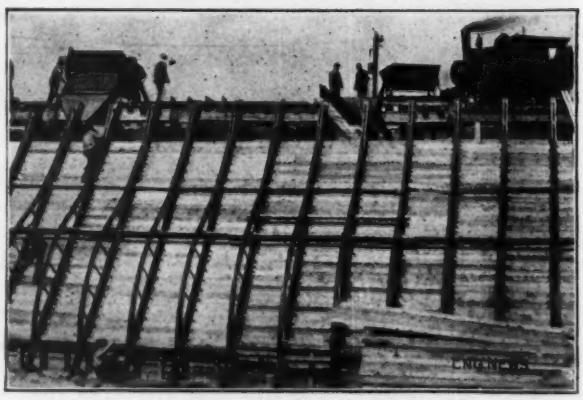


FIG. 10. CONCRETING THE SPILLWAY SECTION OF THE COON RAPIDS DAM

(The steel ribs of the form are anchored to the foundation piles, to resist the pressure of the concrete, which is dumped directly into place through the portable hoppers.)

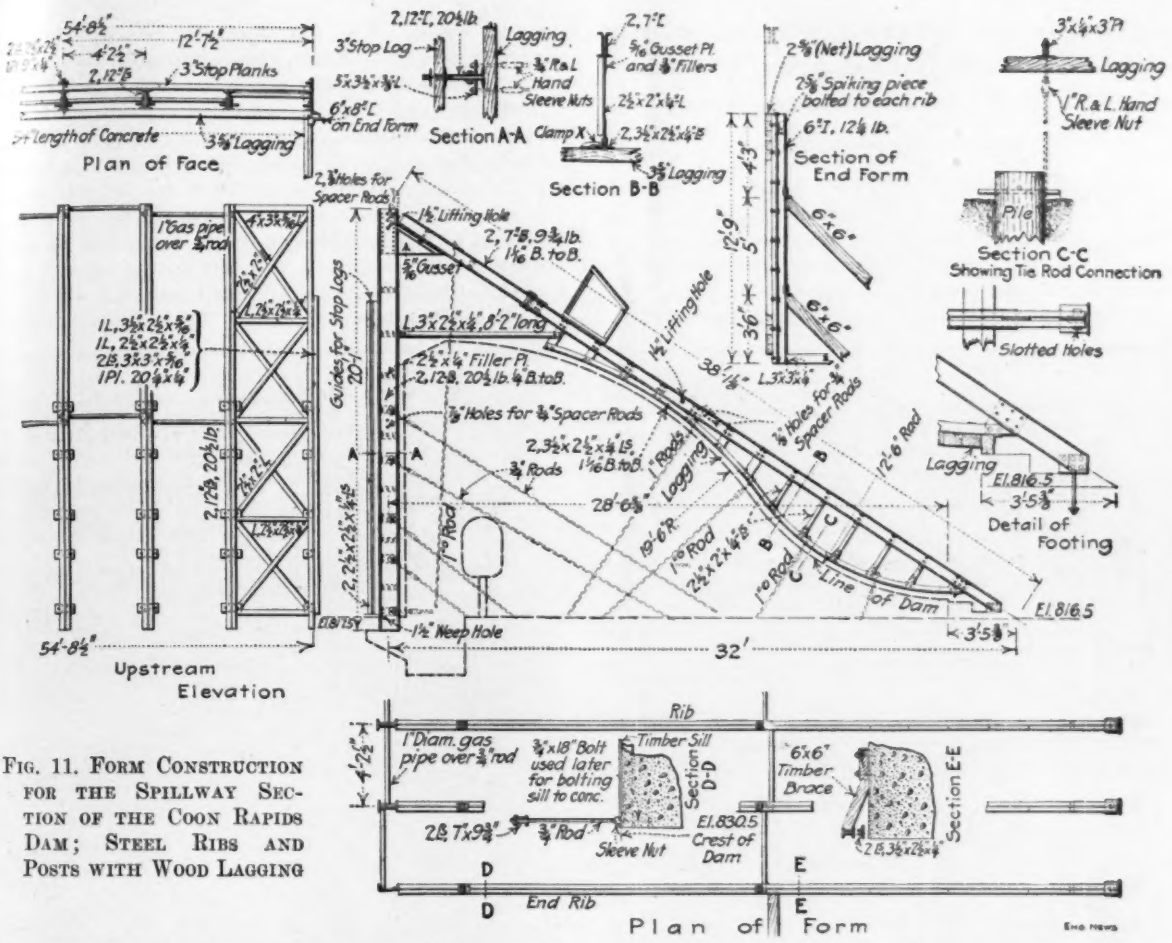


FIG. 11. FORM CONSTRUCTION FOR THE SPILLWAY SECTION OF THE COON RAPIDS DAM; STEEL RIBS AND POSTS WITH WOOD LAGGING

with planking, temporarily, and were finally closed, with the steel forms serving as coffer-dams.

The forms for the scroll cases and draft tubes (Fig. 8) were made in sections, and were collapsible. In this way they were readily assembled and removed.

Sweeping over Macadam and Gravel Roads as a Maintenance Measure

In an article on road maintenance in the *Quarterly Bulletin* of the Philippine Bureau of Public Works, for April, 1914, J. L. Harrison gives some valuable information on road-maintenance problems in the tropics. The following paragraphs advocating the regular sweeping of macadam and gravel roads are particularly interesting, since few states in this country have as thorough or as efficient a maintenance organization and methods as the Philippine Bureau of Public Works.

Mr. Harrison writes: All roads should be swept frequently. This is not because their appearance is thereby improved, though it is undoubtedly true that the neat appearance of a clean right-of-way is very pleasing to the eye; but because of distinct benefits that accrue to the highway itself. All sorts of litter accumulate on an unswept road. That which is not removed either grinds to dust under the wheels of passing vehicles and in this form is mixed with the stone dust and prevents it from properly performing its functions, or washes into the ditches where it causes serious annoyance by collecting about obstructions and causing overflows.

The regular sweeping of a macadam or gravel road also aids in preventing rutting. Many animals instinctively follow paths or trails. Those used in domestic service show very marked tendencies in this direction. If a little fine loose gravel is present, the sweeping of a highway will obliterate wheel tracks. With these out of sight draft animals will make no effort to keep on any particular part of the road surface and a more equal use of the whole of the metalled section will result.

The more evenly wear is distributed the longer a road will last. It may, therefore, be advisable to sweep a road quite often simply to obliterate the wheel tracks. The necessity or advisability of such action will depend on the amount of traffic and the kind of material used for metalling. Roads built of hard rock are less affected by traffic and less aided by this treatment than are roads built of softer stones. Gravel roads seem to be helped more than macadam roads.

Of course, the better the binding qualities of the metalling the more advantage there is to be gained by frequent sweeping for, in the wet season, if the binding quality of the metalling is good, much of the material swept onto the road may bind in and, in that case, not only is rutting prevented but the deficiencies caused by a season's wear may be largely corrected.

Failure of Mixing Flumes for Water-Softening and Filtration Plant, Dallas, Tex.

By N. Werenskiold*

Early in December, 1913, an attempt was made to put the new softening and filtration plant at Dallas, Tex., in operation. Water was turned through the treating and mixing channels leading to the sedimentation basin (Fig. 1), as apparently intended by the plans. Within 21 hr. about 200 ft. out of a little more than 600 ft. of the two basins. The soil when dry has considerable bearing power and cohesion; when saturated with water, as the water side of reservoir embankments will be, it will merely stand on a slope of 2 to 1. It absorbs water readily and holds it well.

Under the engineer's plans, the west basin is to be used for sedimentation, the east basin for filtered water. The raw water was to enter Channel *A* (see large section, Fig. 1) near the division embankment and there be treated with limewater, then to flow to the far end and around the light division wall into Channel *B* and back toward the division embankment. The coagulant was to

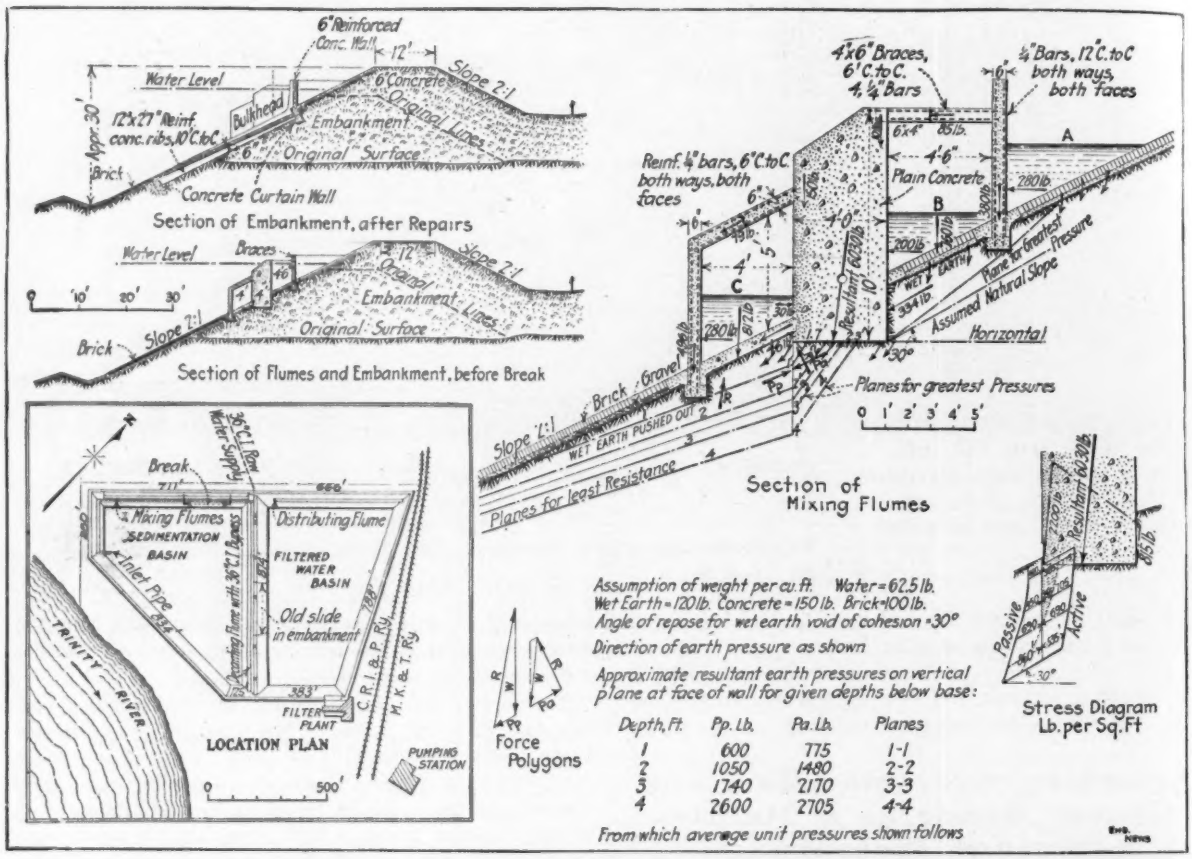


Fig. 1. Mixing Flumes for Filtration Plant, Dallas, Tex., with Sections and Diagrams Showing Cause of Failure and with Location Plan

the flume failed (see Fig. 2). According to the best information obtainable the slope below the flume bulged out and part of the embankment with the heavy walls of the flume slid gradually down, making a crunching noise and producing tremors felt some distance off. The heavy wall was built on the water slope of a reservoir embankment constructed about 25 years ago.

The two old settling basins (see plan, Fig. 1), each of a capacity of about 65,000,000 gal., were built in and of the alluvial soil in the Trinity River bottom. Their water slopes were protected against wash and wave action by a grouted pavement of common brick, made out of the bottom soil, set on edge and resting on a little gravel plastered with cement mortar. Some old pipes in the dividing embankment makes it possible to connect be added at the far end. By means of gates the treated water could then be turned either into Flume *C* and flow about 800 ft. through it to the inlet pipe to the sedimentation basin, or it could be turned into a 36-in. cast-iron bypass pipe, resting on top of the decanting or outlet flume, and carried to the small reaction tank of the filter plant. A bypass to avoid both flumes and sedimentation basin had also been provided.

Under the conditions of the filling a lineal foot of the flume and walls would be subject to the approximate forces shown on the section (Fig. 1). The vertical plane of the face of the heavy wall extended below the base may be considered as the back of a retaining-wall, which, to prevent the soil from oozing out from under the heavy wall, must offer a greater resistance against sliding on the plane of least resistance than the maximum pressure exerted on its back by the earth under the heavy wall.

*Civil Engineer, Dallas, Tex.

Under assumptions more favorable to the design than any responsible designer would be likely to make, the active and passive earth pressures on the vertical plane have been determined graphically by trials, for different depths, the average unit pressures derived therefrom and shown on a diagram (Fig. 1). The results indicate failure to be reasonably certain.

As a practical demonstration of the need and usefulness of simple theoretical investigations, where precedent, experience or instinct furnish no guide, the design has been a decided success. That only about one-third of the flume failed in one slip may be attributed to varying conditions of the embankment, which had not as yet been saturated by seepage through pavement and construction joints. The embankment could not be expected to support the heavy wall, if there was no water in the channels, after it had been saturated. With water in the basin and corresponding pressures on the slope, the passive pressures would have been far greater; but wave actions might have a disturbing effect.

These extracts were sent to us by Mr. Werenskiold, with the statement that they were taken from the Dallas *Morning News* of Dec. 13, 1913.—EDITOR.]

On Dec. 1, at 1:09 p.m., Mr. Morey, in the presence of the representative of the American Water Softener Co., turned the water into the west basin, through the mixing channel, at the rate of 11,000,000 gal. per day. The water continued to flow into the basin at that rate all that night and until 10:10 a.m. the next day, at which time the accident occurred. There was but one eye-witness to the accident, although Mr. Morey was on the wall ten minutes before the break occurred, and saw then no sign of weakness. When the break occurred a considerable length of the wall seemed to have been undermined at the same instant, the first thing noticed having been the bulging of the slope pavement in a line about 7 ft. below the lower channel; this was followed by the immediate discharge, below the foundation of the wall, of water and mud behind the three parallel walls and the falling flat on its north face of 150 ft. of the collapsed section.

As above stated, the water was brought into the basin through the mixing channel, which was not the proper procedure as, with the basin empty, this would bring pressure on the walls which they were not intended to bear. The basin should have been filled up to nearly the full operating depth through the bypass pipes before permitting the water to flow through the mixing channels, the walls of which were intended merely to divert the course of the water slowly back and forth across the end of the basin to allow it to mix for half an hour with the added chemicals before entering the basin.

By filling the basin through the mixing channel the water got through cracks in the old slope pavement and, working down through the gravel under the pavement, brought up against the heavy wall, and backing up, caused excessive pressures.

Had the basin been filled through the bypass there would have been no pressure against the wall when the water was admitted through the mixing channels, and had the backfilling behind the big wall been rammed in, watertight, and the slope paving over this filling been promptly replaced, as directed, the wall would not have failed under the pressures actually exerted, as is shown by the fact that more than two-thirds of the wall still stands intact, and undisturbed even by the violent strains therein caused by the failure of part of it, and that the part that failed is the part from behind which the replacement of the paving was longest delayed.

The portion of the wall that failed is about 200 ft. long, the undermining of this portion displacing and damaging the adjoining sections for a short distance on each side. The failure of the wall destroyed the old slope paving for a corresponding length and for from half to two-thirds the full depth of the slope. The fallen sections of the wall lie nearly flat on this slope, at the middle of the break, and range from this position to a standing position at the two ends of the break; all three diverting walls were destroyed for the width of the break.

There appears to be no further tendency for the walls to slide or move, either as to the uninjured parts, or as to the

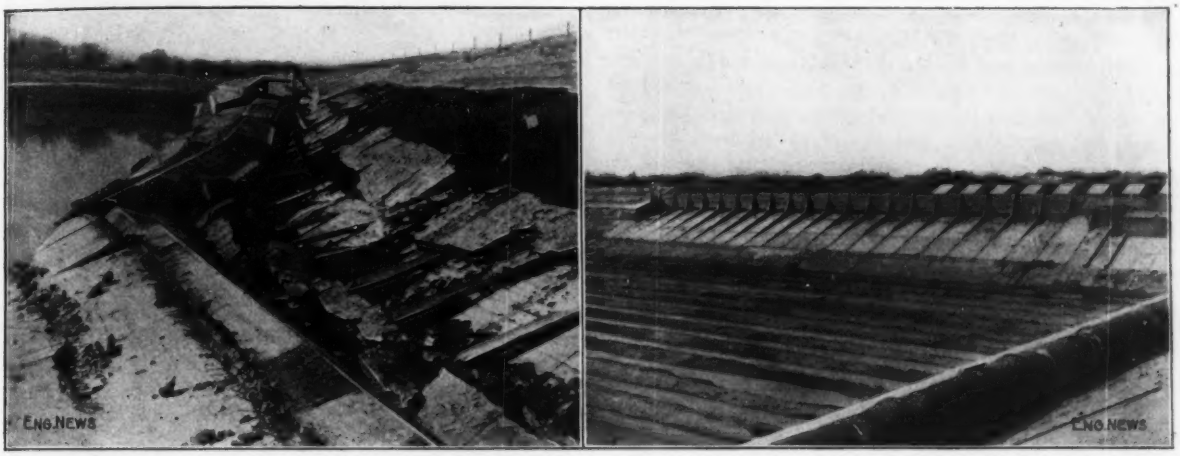


FIG. 2. VIEWS OF MIXING FLUME, DALLAS FILTRATION PLANT, LOOKING WEST FROM DIVISION EMBANKMENT
(1) Original flume, immediately after failure. (2) Upper channel (see sections, Fig. 1) reconstructed along length of broken portion.)

In making the repairs the Channels *B* and *C* (see large section, Fig. 1) were bulkheaded off at the break and shortened about 300 ft. The Channel *A* was maintained by supporting the light wall on buttresses and ribs, 10 ft. c. to c., reinforced and provided with curtain walls, as shown by one of the small sections (Fig. 1) and the photograph (Fig. 2). During the latter part of April, the sedimentation basin was partly filled from and through the filtered-water basin by pumping raw water through same, and also through the east end of Flume *C*, which has been converted into a bypass to avoid the use of the other channels in filling. The plant is now (May 11, 1914) reported to have been in successful operation for a few days without any new accidents having been made public. When the water in the sedimentation basin is drawn down some distance below the flume, as it is likely to be sooner or later from some cause, more of the original flume can be expected to take a very natural course down the slope.

CONSULTING ENGINEER'S REPORT ON THE FAILURE

pieces which fell, and I believe it would be unwise to disturb the fallen pieces on account of the treacherous nature of the soil and its liability to cave, settle and slide when saturated with water and disturbed. I would also hesitate to restore the original slope to this embankment, fearing the reproduction of the conditions that gave so much trouble in the repair of the broken cross-wall.

After stating that it was possible but not advisable to put the filtration plant in operation regardless of the break, although the softening process could not be used until the west basin was made available, Mr. Fuertes discussed repairs to the break in the mixing flume as follows:

It will not be advisable, as above stated, to attempt to replace the slope paving at the break, on the original lines. A treatment similar to that adopted for the old broken cross-wall [not here described.—Ed.] will be required, though it will be less extensive as the caving is much less pronounced and the soil firmer. It will not be feasible, except at considerable cost, to replace all the broken cross-walls, on account of the difficulty of getting proper foundations, but the portions now standing can be utilized by building bulkheads up the slope, each side of the break, and properly connecting the channels across the break in a manner that I will show in drawings which I will prepare after the surveys now in progress are completed. I have made a number of studies for different plans for accomplishing the desired results, and the approximate estimates of cost indicate that an expense in the neighborhood of $5000 will be involved in making the repairs.

We are informed by Mr. Fuertes, under date of June 23, 1914, that the repairs to the flume were carried out in accordance with the general plan outlined in the paragraph last quoted and that the plant has been in operation six weeks. Mr. Fuertes also states that some of the discussions of the break have been "based on the erroneous assumption that the wall which failed was intended to act as a dam or retaining-wall."

Experiments with Screw Spikes and Auxiliary Rail Fastenings; Pennsylvania Lines

Some extensive tests have been made on the Pennsylvania Lines to determine the efficiency of screw spikes as rail fastenings, and to determine also the value of some supplementary devices which are employed in Europe to increase the holding power of screw spikes in the ties. The results were far from satisfactory, although the screw spike has been generally considered as a very efficient rail fastening. Two supplementary fastenings were used: (1) the Thiollier lining,* which is a steel-spring spiral screwed into a thread in the spike hole, in order to compress the wood in which the thread of the screw spike cuts its way; (2) the Lakhovsky lining, which is a split sleeve inserted in the bored hole and forming a threaded socket for the spike, the sleeve being spread outward against the wood as the spike is screwed home. These linings are shown in the accompanying cut.

The tests were undertaken by W. C. Cushing, Chief Engineer of Maintenance-of-Way, Pennsylvania Lines (Southwest System) and were in charge of R. D. McKeon and W. D. Wiggins. A review of the tests and their results has been published in Bulletin No. 165 of the American Railway Engineering Association, and we give herewith a brief summary of the reports. The introductory statement by Mr. Cushing is as follows:

The experiments described were undertaken by the writer to determine if it would be possible to find suitable rail fastenings which would enable us to obtain the full life of a preserved wood tie. It seemed quite doubtful whether the fastenings heretofore proposed would last sufficiently long for the purpose, and suspicions against the screw spike were aroused by the fact that in Europe it was necessary to invent various methods of repairs, such as the wooden screw plug,* the Collet wooden screw trenail, the Thiollier helical lining and the Lakhovsky cast-steel lining.

The methods used in placing these screw spikes were those in common use in France, and the screw spikes used were obtained from France. The trial shows that the screw spikes were too small, the method of placing (without shoulder support for the head) defective, and the problem of rust is still so serious that such kinds of fastenings are rendered ineffective in altogether too short a time.

As a result of these tests, more elaborate tests have been inaugurated on the Pennsylvania R.R. and the Pennsylvania Lines, which are under the charge of a joint committee. The screw spike used is much larger and is the result of study made by the writer. Some of the same difficulties are arising in the new tests, which clearly show that a screw spike is not a successful device for securing rails to wooden ties, unless a successful method of repairs from time to time can be devised, which will enable one to "cure" the screw spike when it becomes loose, which it does inevitably in the course of time in many instances, under heavy traffic and severe conditions.

Indeed, it may be found ultimately that the practice of the Great Western Ry., of England, in using bolts clear through the ties, may be the most successful plan.

A condensation and some direct quotations from the two reports follow:

Ties and Fastenings†

The French screw-spike (Eastern Ry.) used in the test is 5½ in. long under the head, ½ in. diameter at the root of the thread, increased to $\frac{13}{16}$ in. at the shank to insure tightening in the last turn of the spike. The pitch is two threads per inch. The head has a square top tapering from ¾ in. to ⅝ in. for engaging the socket wrench, but this should be made without a taper, as it causes the wrench to lift when the screw is being seated. There were 18,000 of these spikes and the spiral linings. The tie-plates were of the flat-bottom type, 6x9 in., $\frac{1}{4}$ in. thick.

Quoting now from the report:

On hewed ties, the rail seats were adzed by hand, a template being used to insure accuracy. Holes were then bored through the tie with ordinary auger and proper spacing template. The boring may be done by hand or power. In this case, a portable air-compressing plant (made for use in bridge riveting) was used, with a wood-boring air motor.

It is necessary to bore the holes entirely through the ties, as the thread-cutting tool could not otherwise be used, due to the accumulation of shavings from it in the bottom of the hole. The holes were then tapped with a special thread-cutting tool, furnished by Thiollier. The diameter of the tool at the root of the thread is the same as the diameter of the hole. This operation may be performed by hand, or with a boring machine. In this experiment, a compressed-air plant and a heavy air-motor were used.

The screw spikes were run down three-fourths of their length with an alligator wrench and tightened by means of a socket wrench about 30 in. long, equipped with an ordinary brake-wheel at the upper end. Two men were required for operating each wrench.

The helical lining is then seated in the hole by means of a driving mandrel, on which the lining is placed, the lining being pulled into the tie. Great difficulty was experienced in placing the linings by hand. When the lining was partly in place, the friction between it and the wood became so great as to straighten out the bend which engages the mandrel, permitting the latter to turn in the lining. In this event, it became necessary to remove the lining from the hole and replace the bend at its lower end, or replace the lining itself with a new one.

The removal of the lining was accomplished with difficulty and many were broken during this operation, or in replacing the bend so that it might again be driven into the tie. Various attempts were made to overcome this difficulty. Both

*"Engineering News," June 21 and Aug. 23, 1906.

*"Engineering News," Oct. 19, 1914.

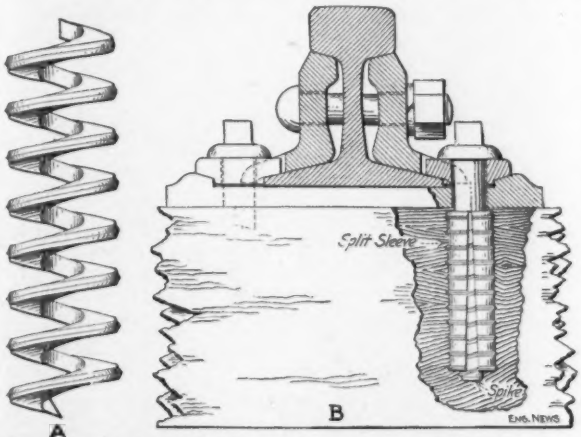
†From the report of W. D. Wiggins, Division Engineer, Pennsylvania Lines, Pittsburgh Division.

the diameter of the hole and the size of the thread were increased, within limits, without much success. A slight increase in the size of the hole, or of the thread-cutting tool, resulted in the lining being too loose and coming out with the screw spike when there was occasion to remove it. A new design of driving tool was finally devised with a shoulder to engage the upper end of the lining, in addition to the one at the lower end. This tool pushed, as well as pulled, the lining into place. Some improvemnt was effected by the use of this tool, but the difficulty was not entirely overcome. It would be necessary to use special machinery for executing work of this character.

The cost per tie was $1.78 with common spikes and $2.16 with screw spikes and spiral linings. The cost includes the creosoted tie, spikes, tie-plates, linings, adzing, unloading and piling ties, placing ties and surfacing track.

Results of Tests*

The screw spikes and Thiollier helical linings for the spike holes were installed during June to November, 1907, in ties of Kentucky short-leaf pine and red oak, treated with 2½ gal. of creosote per tie (0.33 gal. per cu. ft.). After an inspection of the track in February, 1913,



French Devices Used to Increase the Efficiency of Screw Spikes

(A. The Thiollier steel spring spiral. B. The Lakhovsky split sleeve.)

it was decided that the track would have to be gaged at once, and as this would require common spikes the experiment was closed. The general results were as follows:

The screw spikes were not large enough and the method of placing them did not furnish enough lateral resistance to prevent the widening of the gage. The tie-plates were almost entirely destroyed by rust and many of the screw spikes and Thiollier linings were corroded badly, so that their holding power was destroyed. This condition is supposed to be aggravated by brine dripping from refrigeration cars, as this traffic is heavy.

The holding power of screw spikes is greater than that of the hook spikes commonly used, but the forces tending to loosen them are very great, unless the surface of the track is kept in a high state of perfection. The spikes in loose ties are apt to be quickly loosened by having the threads in the wood destroyed. The above defects having developed in 5½ years, it appears that the fastenings must be adapted for repair work or the full life of creosoted ties cannot be obtained.

There were more loose screws where the tie-plates were used, owing to the corrosion of the plates. The condition of the intermediate screws and tie-plates was very bad, many of the plates having rusted almost entirely away, largely due to the action of the brine from refrigerator cars. The screws in some cases were almost destroyed, their threads having been eaten away, permitting the screws to be lifted out of the ties. Many screws were worn under the head and bent. The bending could be overcome by designing a tie-plate that would support the head of the screw and assist in resisting the lateral thrust of the rail. The tie-plates had all cut into the ties about ¼ in., as had the rails on the ties without plates. Some ties were crushing under the plates. The joint screws and plates were in good condition, but some screws could be raised an inch, due to the tie decaying around the lining.

It is impossible to extract the Thiollier linings or to introduce new spikes with good results. Therefore, the Lakhovsky linings were introduced at the joints, in new holes, to compare them with the other lining. At the time of inspection the joint screws which were installed in 1910 with Lakhovsky linings, clips and larger tie-plates, were giving satisfactory service. They were not bent and all were in good condition with the exception of a few of the linings being loose. At a great many of the joints, the rail, tie and tie-plates seemed to be held firmly to each other, and the entire joint moved up and down under traffic. The joints were all in fairly good line and surface, and this type of fastening seemed to give much better service than the smaller intermediate screws.

CONCLUSIONS: 1. Screw spikes offer a greater resistance to extraction, and will remain tight for a longer period than common spikes if the track is well maintained.

2. By greater holding resistance they tend to reduce creeping of rail and also to prevent the slewing of the ties, but this action is not complete.

3. The screw spikes do not cause the ties to split, as do the common spikes, on account of boring the holes in advance.

4. The cost of maintenance of track for screw spikes is from two to four times as great as for common spikes.

5. Screw spikes cost from two to three times as much to apply as common spikes, and first cost is considerably greater.

6. When screw spikes break, it is impossible to extract the stump from the hole, and when tie-plates are used, it is either impossible or very costly to exchange the tie-plates, so as to allow the proper number of spikes to be used. This might be a very serious matter when the spikes are cut off by a derailment.

7. It is impossible to gage the track which is laid with screw spikes or to straighten rail which is canting on curves, when placed in accordance with the plan used for this experiment.

8. It is impossible to remove screw spikes which have rusted, in order to replace them with new ones.

9. Tie-plates with bosses supporting the heads of the spikes and screws with heads beveled to fit the rail would decrease the lateral thrust and would offer a greater resistance to the rail creeping.

10. Larger tie-plates are required, as those which were used cut into the ties badly.

11. It would seem desirable to fasten the tie-plates to the tie with screw or common spikes so that the sawing action of the plate, under traffic, would be eliminated and reduce the cutting of the plate into the tie. The plate must be held firmly to the tie.

12. Heavier screws are needed, and two screws per rail on the inside should be used on curves to prevent canting and assist in maintaining the gage.

13. The screws should be applied by some mechanical device, so that each screw would bear equally against the rail. By applying screws by hand, equal bearing is not obtained.

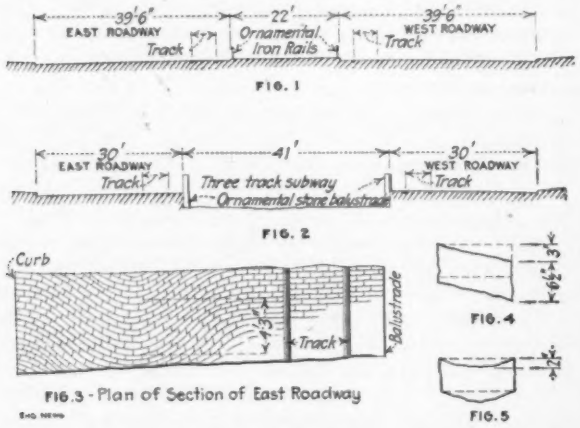
14. Some method should be devised to overcome the effect of the brine from refrigerator cars on track fastenings. The failure of these fastenings was due largely to the corrosion of tie-plates and screws.

*From the report of R. D. McKeon, Assistant Division Engineer, Vandalia R.R.

Remarkable Instance of the Creeping of Asphalt-Block Pavements

By J. H. Gandolfo*

The following description of a creeping pavement that has recently come under the writer's notice, illustrates one of the most advanced cases of such an occurrence of which he has ever heard. The conditions tending to produce the creeping are, however, probably more severe than those ordinarily found on the average city highway.



Plan and Cross-Sections of Upper Broadway, New York City, Showing Creeping of Asphalt-Block Pavement

Upper Broadway, in New York City, is a wide thoroughfare, with two sidewalks, two roadways, and a grass plot in the center, as shown in cross-section in Fig. 1. This avenue runs approximately north and south, the east roadway being used exclusively for northbound traffic and the west roadway for southbound traffic. Along each side of the grass plot is a trolley track (underground contact system).

The Broadway branch of the subway passes under the avenue, and between 121st Street and 122nd Street the trolley tracks diverge, narrowing the roadways to 30 ft. wide, in order to provide room for the three tracks of the subway, which comes out at 122nd Street in open cut, preparatory to crossing Manhattan Valley on a steel viaduct. The cross-section of Broadway at this point is shown in Fig. 2.

Beginning at 118th Street and extending north to Manhattan Street (128th Street), a distance of ten blocks, is a down grade of from 4% to 4½%. The street is paved with sheet asphalt from 118th Street to the north side of 119th Street; but from here on to Manhattan Street the pavement is asphalt blocks. These blocks are 5x3x12 in. laid flat (5x12-in. surface exposed), in ½-in. cement mortar on a concrete base 4 in. thick. This pavement was laid in 1905.

In addition to the ordinary street traffic of a large city, upper Broadway is subject to a very heavy automobile traffic, as this street is the main artery from the west side of the city leading to the bridge across the Harlem Ship Canal at Spuyten Duyvil. This is the only bridge for vehicles across the river and canal on this side of the city leading directly north.

Under this heavy traffic, the blocks of the east roadway (the down grade) have at various points moved bodily from their original positions, until the lines of blocks have assumed positions as shown in Fig. 3. There does not seem to be any regularity in this movement, some sections of the avenue being apparently free from any considerable movement, while other sections exhibit a large displacement. This displacement seems to have reached a maximum just north of 122nd Street, where the pavement is now in poor condition. Here the movement of the blocks has reached the astonishing amount of over 4 ft., as shown in Fig. 3.

Creeping of Asphalt-Block Pavement; Patch of New Blocks, Ocean Ave., Brooklyn

The following comparison will give an idea of the singular variation in this movement, the reasons for which the writer is at a loss to understand:

119th St. to 120th St., 3 ft.
120th St. to 121st St., very little movement.
121st St. to 122d St., from 1 ft. 9 in. to 2 ft. 3 in.
Just north of 122d St., 4 ft. 3 in. (the maximum).
122d St. to 123d St., badly creeping, but difficult to follow the lines of the blocks in order to measure the displacement.
123d St. to 124th St., 1 ft. 10 in. to 2 ft. 3 in.

*Care of J. G. White Engineering Corporation, 43 Exchange Pl., New York City.

124th St. to 125th St., fairly regular except just north of 124th St., where there is a displacement of 2 ft. 6 in.

125th St. to 126th St., here the roadway widens again, the car tracks being carried in under the viaduct. From here on to Manhattan St. there is very little displacement.

The strain of this movement on individual blocks has been such as to cause them to assume various shapes and dimensions, two maximum cases of deformation being illustrated by Figs. 4 and 5. From these it will be noted that whereas the blocks were originally 5 in. wide, some are now 6½ in. wide, and have been bent and twisted 2 and 3 in. from their original rectangular shape. Of course, it is to be remembered that all these figures are taken from surface measurements, and the blocks are perhaps not so badly distorted deeper down.

Owing to the creeping of the surface of the blocks over the joints between them, combined with the oil drippings from automobiles, the joints are practically obliterated over large areas of the pavement, and it is therefore impossible to follow the lines of the blocks at all on these areas. Indeed, it takes close scrutiny at places to tell the surface from that of the ordinary sheet asphalt.

In making necessary repairs, the blocks have been cut out in the worn portions, and new blocks, 5x2½x12 in., put in place in regular rows perpendicular to the curb, no attempt being made to follow the reversed curve assumed by the old blocks.

There is no way of telling, at present, whether there has been any movement of the concrete base, but it is the writer's opinion that there has not been any very serious displacement. Apparently all the movement has taken place between the blocks and the concrete base; the cause, of course, being the very heavy traffic on a down grade and all in one direction.

On the west roadway, where the traffic is uphill, there has been some little movement at some points, but it is of small amount and very irregular. The general tendency, however, seems to be a movement *up hill*, on this side of the avenue.

Creeping of Asphalt-Block Pavement on Ocean Ave., Brooklyn, N. Y.

Some of our readers will recall a letter published in our columns of Dec. 25, 1913, p. 1315, calling attention to the creeping of the asphalt-block pavement on Ocean Ave., Brooklyn, N. Y., in much the same manner as the pavement described above by Mr. Gandolfo and to a maximum displacement of 4 ft. 6 in. The blocks on Ocean Ave. are 5x2¼x10 in., laid in the same manner as on Broadway. Here also the same reversed curve was noticeable although this avenue is not divided by car tracks.

The accompanying illustration shows a patch of new blocks, placed recently on Ocean Ave. The pavement was put down in the summer of 1910, and is apparently being repaired under the guarantee clause of the contract. In some cases the old blocks are being cut out so as to make a regular-shaped patch, but in many instances the patching is like that shown in the illustration.

This method of failure seems to be common on all the heavily traveled streets in the city which are paved with asphalt blocks. A portion of Flatbush Ave. on a considerable grade shows the same tendency of the blocks to creep or flow *up hill*, as noted by Mr. Gandolfo on Broadway. The cause is the same in all instances—the heavy motor-vehicle traffic always in one direction.

The chart and photograph are particularly interesting as illustrating graphically the strains every pavement surface is subject to. Probably all bituminous surfaces flow or creep in exactly the same manner, but owing to the absence of joints the movement is not so easily detected.

It has been suggested that regularly spaced ribs in the concrete foundation would help to eliminate this trouble. These ribs might be 10 in. wide, perhaps, and come to 1 in. of the surface of the pavement. Over the ribs, special blocks 1 in. thick could be laid, so that the asphalt surface of the pavement would be unbroken.

Slate Beds and other Features of the Devizes Sewage Works

About nine years ago, W. J. Dibdin, of London, England, included slate-contact beds as a part of sewage-treatment works for the small town of Devizes. The following description of the works as they now stand is slightly condensed from notes by Alan J. King, in the *Journal* of the Institution of Municipal and County Engineers (London) for April, 1914.

The plant consists of a total of 18 beds, 8 coarse (2 of these being for storm water), and 10 fine. The coarse beds are 68 ft. long by 48 ft. broad, and are filled with layers of slate about 1 in. apart to a depth of about 4 ft. The storm-water beds are similar, only bigger, being 80 ft. long by 68 ft. broad. These are used when the sewage to be dealt with is more than can be treated by the first six coarse beds, which only happens during very wet weather, and the effluent, after having been through these beds, is allowed to run away without further treatment.

The fine beds are the same size as the coarse beds, and are filled for a depth of about 4 ft. with coke breeze, which has been previously passed through a screen. These beds require renewing about every five years, but the slate beds being once well laid will, with a little attention, last indefinitely. There are also two grit-settling tanks which belonged to a former system, and are now used for allowing the grit to settle after a heavy storm.

The sewage is a dense domestic one about 240,000 [U. S.] gal. per 24 hr., and has the storm water included with it.

Except after heavy rain, when the grit chambers are first brought into use, the sewage is run straight on to the primary slate beds, consecutively, each one taking about 2½ hr. to fill. After standing for about 3 hr., it is run in the same way on to the secondary coke breeze beds and allowed to stand the same time. Then it finally finds its way by a channel over the land immediately below the sewage farm and eventually into a brook.

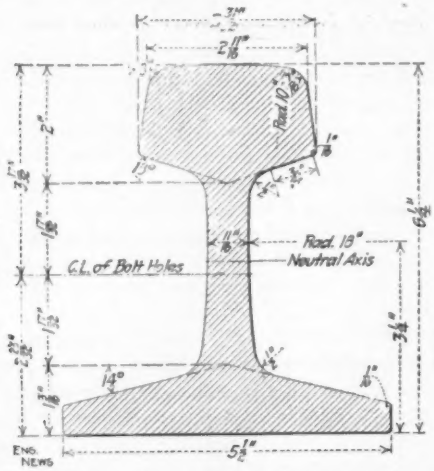
By the time the effluent has come from the fine beds it is very good, so that when not wanted on the land, it is allowed to run straight away into the brook without causing any ill effects.

The whole plant employs 3 men (2 by day, and one for night duty), and the cost is under $1000 per annum. All this amount is practically for wages, and the cost appears to much advantage when compared with the system of pressing the sludge with lime, which was formerly used, and which besides resulting in a large amount of sludge, caused an annual expenditure of nearly $3500.

New 120-lb. Rail Section; Pennsylvania R.R.

The 100-lb. rail, of different sections, has for some years been the maximum size of rail for steam-railway track, but the possible necessity and economy of using heavier rails on lines carrying heavy traffic has been suggested from time to time, and the Pennsylvania R.R. has now decided upon trials of a 120-lb. rail. This rail is of an experimental character, and the section is shown in the accompanying cut, while its dimensions are given in tabular form.

In general, the new rail resembles the heavy-base rail (type B) of the American Railway Association sections, but with some important modifications. The proportions of this 120-lb. rail are 41, 22 and 37% for the head, web and base, as compared with 40.2, 19.2 and 40.6% for the 100-lb. A. R. A. (B) rail. The sides of the head have an unusually steep slope (8° as against 3°), while the top of the head has the short radius of 10 in. (as against 12



EXPERIMENTAL RAIL OF 120-LB. PER YD., PENNSYLVANIA R.R.

in.), and corner radii of $\frac{7}{16}$ in. (as against $\frac{3}{8}$ in.). The fishing angles are 18° for the head and 14° for the base, while in most rail section the angles are uniform and those of the A. R. A. sections are 13°. The height is 6¼ in. as against 6 in., but the width of base is the same, since the use of tie-plates obviates any necessity of increasing the bearing surface of the rail.

The nearest approach to this new section is the 110-lb. rail of the Lehigh Valley R.R., described in ENGINEERING NEWS, Oct. 24, 1912, and designed for use where heavy grades and sharp curves cause severe conditions of wear. In this case, the height remained 6 in., the same as the A. R. A. (A) section, forming the standard rail, but metal was added to the web and head. This 110-lb. rail (like the new P. R.R. rail) has a 10-in. top radius, instead of the 14-in. of the A. R. A. (A) section. The sides of the head have a slope of 4° (instead of 3°), while the Pennsylvania rail reverts to what has long been an obsolete practice in giving a much greater flare to the head.

This practice was introduced originally on the Lehigh Valley R.R. by Sayre, whose 76-lb. rail of 1883 had a flare of 10°, as against 8° in the new Pennsylvania rail.

120-LB. RAIL; PENNSYLVANIA R.R.

Weight, per yard	120 lb.
Height	6¼ in.
Width of base	5½ in.
Width of head, top	2 11/16 in.
Width of head, base	2 3/4 in.
Side of head, slope	8°
Depth of head	2 in.
Depth of web	1 31/32 in.
Depth of base	1 3/32 in.
Thickness of web, middle	13/16 in.
Height to center of bolt hole	2 3/32 in.
Radius, top of head	10 in.
Radius, top corners of head	7/16 in.
Radius, bottom corners	7/16 in.
Radius, fillets	1/2 in.
Radius, corners of base	1/2 in.
Radius, sides of web	18 in.
Edge of base	Vertical
Fishing angles, top	18°
Fishing angles, bottom	14°
Area of head (41%)	4.84 sq.in.
Area of web (22%)	2.60 sq.in.
Area of base (37%)	4.38 sq.in.
Area, total (100%)	11.82 sq.in.
Moment of inertia	59.20
Section modulus, top	17.77
Section modulus, base	20.00
Neutral axis above center of bolt holes	3/8 in.
Ratio of perimeter to area: head	1.43
Ratio of perimeter to area: web	2.98
Ratio of perimeter to area: base	2.37
Ratio of perimeter to area: total	2.12

The flare in the Lehigh Valley rails was reduced to 5° in 1891, and since then it has been limited to 3° to 5° in most rail sections. Presumably the present revival of the flaring head is due in part to considerations of flange wear on curves.

An article describing several so called "frictionless" rails for use on the inside of curves appeared in ENGINEERING NEWS, July 2, 1914, p. 20.

Fire Hazard from Refuse Incinerating Plants, Galveston, Tex.

A brief report on fire dangers from city and private refuse-burning plants at Galveston, Tex., was recently made by the Committee on Fire Prevention of the National Board of Fire Underwriters (135 William St., New York City) following a recent visit by Mr. Goldsmith, one of the committee's engineers. The committee's remarks on the city's plant are substantially as follows:

The city garbage incinerating plant consists of a two-story, iron-clad frame building, with open first story adjoining a concrete furnace with concrete stack. Combustion is augmented by oil burners. The chimney is equipped with a spark arrester. The plant has proved to be not well designed to eliminate the fire hazard.

The nearest exposure is a cotton platform 250 ft., to the east, where several minor fires, caused presumably by sparks from the incinerator, have been put out with a bucket of water by the watchman. These fires were probably due to the poor condition of the spark arrester, the screen of which is rapidly deteriorated by the fumes. It is reported that the clinker is not always wet down by the attendant when it is drawn from the furnace, and this is likewise a possible source of fires.

After commenting on a number of private incinerators, which are of local interest only, the report concludes:

The city is considering the construction of modern incinerating plant, about 300 ft. from pier sheds.

It is believed, from knowledge gained by the inspection of a newly erected plant in Atlanta, Ga., and of the conditions under which other modern plants are operated, that a properly designed and constructed plant, which gives complete combustion and provides for safe disposal of the clinker, will introduce no hazard at the proposed location.

The operation of a number of scattered plants should be discontinued, and all burning of refuse confined to a single plant at which the hazards are more carefully safeguarded than it has been in the past; the high winds, coupled with large cotton storages in the open, render such processes enormously hazardous when carelessly handled.

Remarkable Day-Labor Municipal Construction in Minneapolis

By E. M. Richter*

Minneapolis, the first important city in the United States to depart from the contract system on public work, has ordered this year more than $3,500,000 of municipal construction under the day-labor plan, carried out by the city engineering department. Many other cities have adopted the day-labor plan more or less extensively, but none has developed it to the same degree as Minneapolis.

More important items on the 1914 schedule are enumerated in the following tabulation. This does not include the ward street work and sprinkling, in which the day-labor plan also obtains, and many other minor items; the total goes well past the $3,500,000 mark. Further, it does not include betterments in the parks, libraries, hospitals, etc. The latter works are under boards or commissions, independent of the city council under which the engineering department operates. In the boards the contract system is chiefly employed, despite the success claimed for the day-labor plan by its friends.

MINNEAPOLIS PUBLIC WORK TO BE DONE BY DAY LABOR IN 1914

Concrete bridges	$865,000
Paving	750,000
Sewers	680,000
Filtration plant enlargement	200,000
Water-works distribution system	225,000
Sidewalks	150,000
Good roads (special fund)	100,000
Curb and gutter work	100,000
Bassett's Creek improvement	75,000
River harbor wall	65,000
Total	$3,210,000

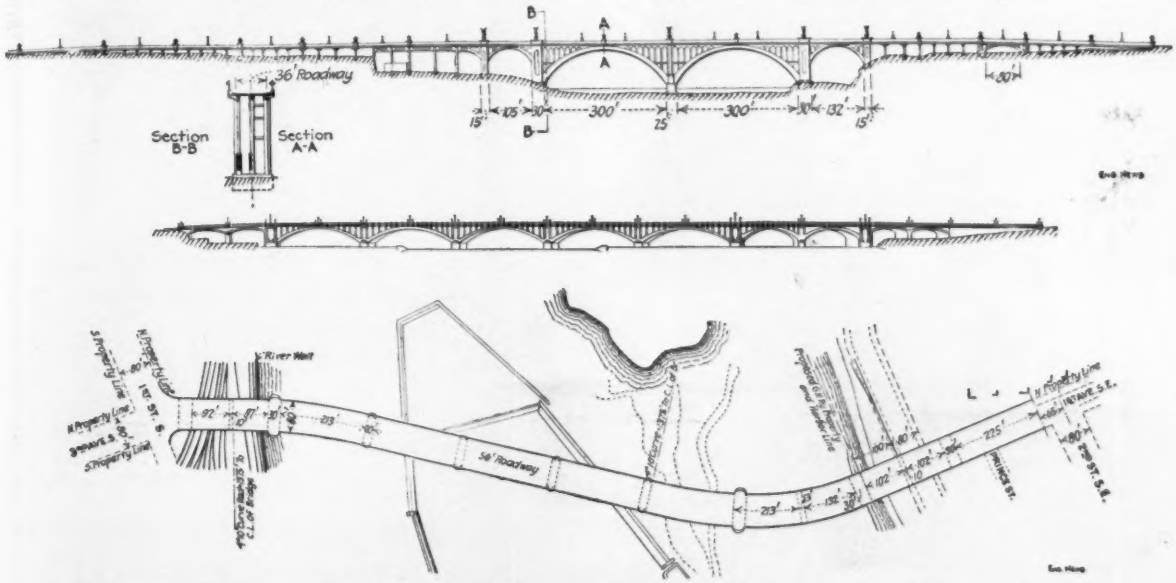
(Minor items add several hundred thousand dollars.)

It is a noteworthy fact that, although permits for private buildings† so far issued in 1914 show a gain of 100% over the same period in 1913, yet the city will be its own largest builder this year. Practically all of this city work has already been put under way and two-thirds of it will be completed by the end of the season. It is carried on under the personal supervision of the city engineer, Frederick W. Cappelen. Nearly 5000 laborers, besides many skilled mechanics, foremen, engineering assistants, etc., are engaged in the work.

Labor Handling

Minneapolis' day-labor work is governed entirely by the municipal civil-service system, inaugurated last July (1913). Common laborers are examined chiefly for physical fitness. Preference is given first to men who have been employed in the same class of work for years by the city, then to American-born men of families—homeowners—over alien labor.

City crews on paving, sewer, water and like construction experience remarkably few changes in comparison with those on like work for private contractors. Two reasons are assigned for that condition: (1) The city is "sure pay"; (2) the pay is always equal to, if not higher than, the common scale, except possibly during the harvest season. The present rate is $2.40 an 8-hr. day for common labor, with handy-men getting 10 to 15c. extra. The council has recommended an increase to $2.50, aldermanic friends of labor contending that the city employees give better service than those of private contractors, even if they are somewhat higher paid; the subject is waiting confirmation by the civil-service commission. Teamsters are receiving $4.75 minimum and $5 maximum.



Two Large Concrete Bridges to Be Built in Minneapolis This Year by City Day Labor
(Upper elevation, Nineteenth Ave. Bridge. Lower elevation and plan, Third Ave., south side.)

Two Large Concrete Bridges

Topping the list of day-labor work is the item of $865,000 for two new ornamental concrete bridges to span the Mississippi River. One is in the heart of the city, at Third Ave. South. The other is at Nineteenth Ave., about a mile below. The former is to have five 213-ft. spans and several shorter spans; the other, two spans of 300 ft. each. The cost estimates, which are thought to be conservative, are $500,000 for the bridge on Third

*Of editorial staff of the "Minneapolis Journal," Minneapolis, Minn.

†Includes a 21-story building already under way, a 27-story building which will be more than half finished by Nov. 1, and numerous other important structures. However, the increase in the permit value is not chargeable to a few unusually large buildings, for the increase in number of permits corresponds to the increase in value.

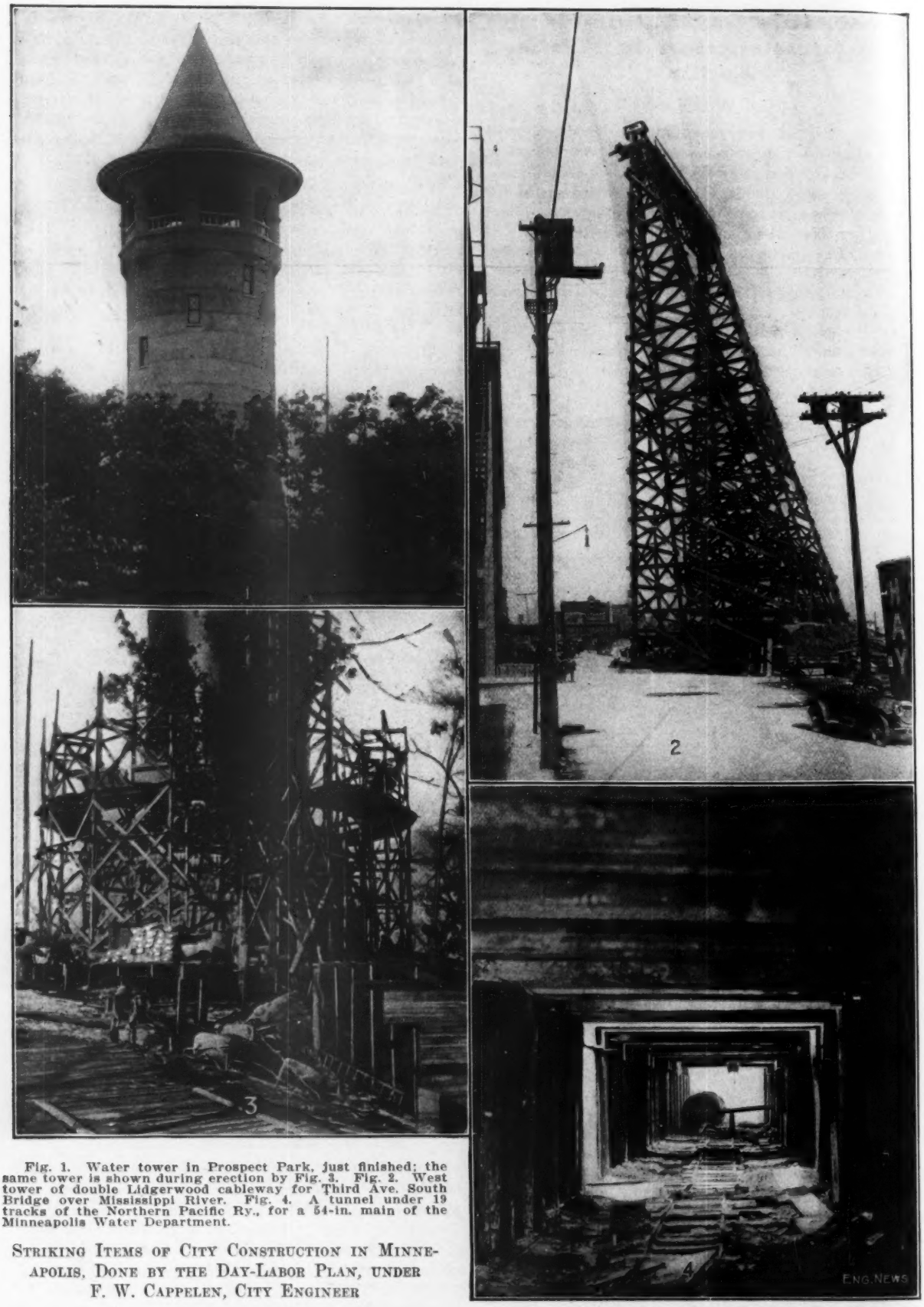


Fig. 1. Water tower in Prospect Park, just finished; the same tower is shown during erection by Fig. 3. Fig. 2. West tower of double Lidgerwood cableway for Third Ave. South Bridge over Mississippi River. Fig. 4. A tunnel under 19 tracks of the Northern Pacific Ry., for a 54-in. main of the Minneapolis Water Department.

STRIKING ITEMS OF CITY CONSTRUCTION IN MINNEAPOLIS, DONE BY THE DAY-LABOR PLAN, UNDER F. W. CAPPELEN, CITY ENGINEER

Ave. (just two blocks from the new postoffice and adjacent to the famous St. Anthony Falls and the great flour-milling district for which Minneapolis is known the world over) and $418,000 for the structure on Nineteenth Ave. Mr. Cappelen and Assistant Bridge Engineer K. Oustad believe, however, that approximately $50,000 may be saved on the construction cost of the latter bridge by using the form material and other equipment used on the Third Ave. bridge.

Sketches of the two bridges are given in the drawing on p. 133.

It may not be amiss to add that the care and maintenance of all the river bridges in Minneapolis are in the hands of the city engineering department.

Paving

Several hundred thousand yards of paving are being laid this year. Creosoted blocks of long-leaf Southern pine are used for the great part of the city paving. The material is popular because there has been practically no difficulty from oozing creosote, buckling and other troubles complained of in some other cities.

A portable asphalt plant, costing about $25,000 equipped, is being operated by the city this year for the first time. It was delivered last fall and used for a small amount of experimental work, which is influencing its use this year. The asphalt crew is putting down principally asphaltic concrete, in most cases as resurfacing on worn brick and granite-block pavement. Orders for this work followed recommendations of Mr. Cappelen that it is both economical and satisfactory.

The general street work is supervised by Assistant City Engineer Ellis R. Dutton, who pays particular attention to paving operations, and is assisted by Street Engineer Benjamin Durham, in charge of grading and other dirt work.

In addition to the large amount of new paving and the ward funds for street work, a special fund of $100,000, proceeds of a "good roads" tax, general in the city, is being used for the improvement of the arterial streets. The ward work, although largely delegated to the street commissioner in each of the thirteen districts, is superintended by Walter Walsh of the city engineer's office.

Sewer Construction

New sewer construction, third in importance on the list, embraces plans for some 20 mi. of sewers, extensions and enlargements of the system, estimated at $680,000, all of which will be completed before snow flies, according to City Sewer Engineer Carl J. L. Ilstrup. It includes the digging of sewer tunnels in the sandrock 80 ft. below the surface through the business district, to relieve overtaxed systems in the district and to provide for business buildings with sub-basements extending below the level of the original sewers. The biggest single sewer project under way is the 10-ft. trunk on Thirty-eighth Street, which is being extended across the southern section of the city from the river at the east limits to the lakes district on the west border, a distance of nearly five miles.

Increased Water Supply

Improvements in the water-works department for 1914 may reach $500,000. Enlargement of the new mechanical filter plant on Columbia Heights just over the north boundary of the city, now in its second year of operation, will increase the capacity from 48,000,000 gal. to about 64,000,000 daily. An additional coagulation basin has just been put into commission to increase the efficiency of the plant, and four additional filter beds (making a total of 16) will be finished about midsummer. William N. Jones, formerly connected with the engineering corps of the Cincinnati filtration plant, in charge of construction here, believes the enlarged plant will be in working order before Sept. 1.

Eighteen miles of water laterals are being laid, under supervision of J. H. McConnell. Demands for extensions were so heavy that the council committee on water-works was forced to limit orders to graded streets, but all these are now to be supplied.

A 50-in. steel main from the filtration plant to the southeastern section of the city, designed to improve pressure conditions in that district, is being laid. The appropriation for it is $45,000.

The water-works extensions are under the supervision of J. Arthur Jensen. The filtration plant is under the superintendency of Lewis I. Birdsall, formerly engaged in a like capacity at Rock Island, Ill.

Valuation and Study of Water Department—With Mr. Birdsall's assistance, City Engineer Cappelen has recently completed a survey of the city water department. A feature of his report is a recommendation that a lime process be adopted to reduce the alkalinity of the city water-supply. The suggestion was approved and the process is to be inaugurated when the plant enlargements are completed.

Street Widening

One of the important items of projected city work is the widening of Seventh St. North, a distance of three blocks in the heart of the business district, and its extension thence in a straight line for about ten blocks through a well built-up residence district. The estimated cost is $567,000. Work will start late this fall or early in the spring, proceedings having already been finally confirmed by the city council.

Bassett's Creek Covering

Bassett's Creek, a stream crossing the northern part of the city, has a history of periodical destructive floods, dating back before the incorporation of Minneapolis. The creek has been a frequent cause of complaint, both for its floods and (in recent years) for its unsanitary condition, produced by rubbish dumps and the like along its banks. The city engineering department is now developing plans to convert the stream into a concrete-enveloped sewer. An appropriation for the construction has been made by the council.

Municipal Harbor Sea-Wall

Finishing the list of regular work committed to the Minneapolis engineering department for execution under the day-labor plan is the item of $65,000 for the erection of a sea-wall, as the first step toward the establishment of municipal steamboat terminals on the river. Minneapolis will be at the head of navigation on the river when the government dam just below the city is completed. The wall is to be started shortly and is likely to be completed this season. Then will follow the building of wharves and warehouses with hoists to elevate the cargoes up the

100-ft. cliff to the level of the proposal municipal belt line to connect with railroads.

Other Work

Additions are being made to the city garbage crematory. A 200-ft. stack is being erected, and preheaters and a forced-draft system are being installed. The incinerators generate steam from which is produced electric current. The station lights and heats the city tuberculosis hospital and workhouse nearby, and operates 200 street arc lights in the surrounding parts of the city.

Day-labor construction is also being used in the erection of warehouses* for the sewer and water departments, at a cost of $25,000. Water-towers have been built for improving the pressure on two elevated areas.

Nor is the story all told. In embryo are projects for a number of municipal ice-houses, a municipal street-railway 1½ mi. long to connect the privately owned city trolley system with the filtration plant, acquisition by the city of the gas plant, and many minor things.

Public-Utility Planning by the City Engineer's Office

The last legislature of Minnesota gave the city's engineering and construction organization a noteworthy endorsement by passing an act which authorizes the city to acquire and maintain a union steam-railway passenger terminal. Similarly extensive powers are vested in the city for the purpose of grade-crossing elimination, for which the city may make complete plans.

Union Station Planning

Efforts in the past to secure a union station in Minneapolis by private action had failed. The legislative authorization to the city therefore opens a way to providing a necessary improvement not otherwise obtainable.

The Great Northern Ry. has just erected a $2,000,000 passenger station, opened for traffic early this year. The station of the Chicago, Milwaukee & St. Paul Ry., four blocks distant, serves several other lines; the Minneapolis & St. Louis and Soo lines maintain separate passenger stations.

The legislative act empowers the city to acquire by condemnation necessary ground for trackage. Proceedings have been commenced to obtain title to a strip about ten blocks long and two blocks wide along the river, in the heart of the city, part of which strip is now utilized for tracks into the Great Northern station. Sketches are being drawn in Mr. Cappelen's office for the station and the entrance trackage. The main feature of the plan is simply to add to the new Hill station an additional wing which will more than double the capacity of the present structure, and to double the station trackage. The city engineer will soon make a tour of Eastern cities to inspect new passenger terminals, prior to the final design.

The most difficult part of the commission was to arrange for all the railways, trackage for both passenger and freight through the district affected. In handling this problem, the aim was to give every railway that enters the city more advantageous facilities than it now enjoys.

Grade-Crossing Elimination

Surpassing in cost the great union-station enterprise, several important grade-crossing eliminations are either under way or projected. Detailed plans for all the separate projects under the general movement have been prepared by the city engineer's department, and in most instances two sets, respectively, for track elevation and for depression. In carrying these projects into effect the procedure will be to order separations by ordinance embodying the city engineer's plans and specifications. The cost of the separations must be borne by the railways, even to damages to abutting property, according to the city's contention.

Depression of the H. & D. tracks of the C. M. & St. L. Ry. across the southern section of the city, embracing the construction of a large number of concrete bridges to carry streets over the railway, is well advanced. This is done under plans made by the railway company. For future work, however, the city will make plans. The city is about to bring an action to enforce depression of the main-line tracks of the C. M. & St. P. between Sixth Ave. S. and Thirty-second St. Depression of the Northern Pacific tracks or their removal from their present location in southeast Minneapolis has just been ordered. Proposals covering other lines in the city are pending.

Municipal Water-Power

Plans are being made for a water-power plant and auxiliary steam equipment to produce electrical energy at the new government dam (nearing completion) in the Mississippi River just below the city. A public corporation, organized and operating under special legislative authority, is confident that the Federal War Department will lease to it the dam power rights for the benefit of the University of Minnesota and the cities of St. Paul and Minneapolis. Negotiations with the Federal officials are under way.

Financing the Elwell Law

Funds are now available for practically all the various undertakings listed in the table given at the beginning of this article. The money comes from sales of bonds, levies of special assessments, and the sale of special certificates of indebtedness under the so called Elwell law.

The Elwell law, embodying a plan entirely new in Minnesota, is designed to aid cities in a stage of rapid development to secure public improvements on a provision for extending assessments in twenty annual installments. It can be made to cover the cost of complete improvements on a street, from condemnation of the land, through grading, laying of water mains, sewer, sidewalk, curb and gutter to paving, or any part of the list as the city council may elect. It provides also for payment from general funds of any part up to 33⅓%, and assessment of the remaining expense to the benefiting—not necessarily abutting—property. The validity of the act has been upheld by the state supreme court and many projects are being carried out according to its provisions.

*

Highway Work in West Virginia—According to recent estimates about $4,360,000 is available for highway improvement work in West Virginia during the present season. Of this nearly $2,000,000 is to be raised by the sale of county bonds, while the remainder is raised by taxation. The Chief Engineer of the State Highway Department is A. D. Williams, and Prof. R. P. Davis, of the University of West Virginia, was recently appointed Bridge Engineer. The state grants aid to counties in the form of convict labor, to be employed under the supervision and in accordance with plans and specifications of the state road bureau.

* For materials bought by the city purchasing agency.

San Francisco's Sewer System

By H. W. Shimer and A. J. Cleary*

Previous to 1900, the sewers of San Francisco were extremely discreditable to a city of its size and prominence. As a general rule, they had been laid haphazard as necessity arose, with complete disregard for every engineering principle of design and construction. No attempt had been made to build any one conduit as an integral part of a logical system, nor did the volume of sewage to be disposed of seem to be regarded as an important factor in determining the size. To run the line down hill and reach the bay as soon as possible, apparently was the only method followed. In September, 1899, the Board of Supervisors appointed a commission to investigate, design and report upon a suitable sewer system, and estimate its probable cost. This commission was composed of C. E. Grunsky, Marsden Manson and C. S. Tilton, with Rudolph Hering as Consulting Engineer. The present system, begun in 1904, follows very closely the recommendations of this commission.

Fig. 1. Relief Map of Main Sewer System, San Francisco, Calif.

Factors for Design

In calculating the requisite size of storm sewers the rainfall rate adopted was 0.598 in. for a continuous storm of one hour duration, while for a period of concentration of 5 min. a maximum rate of 2.16 in. per hr. was presupposed. For intermediate periods the rates were determined empirically.

For a population of 20 per acre a runoff of 30% was assumed, while for districts having 100 residents per acre the runoff was taken as 75%, with an almost uniform increase between these limits. The time element also entered into the calculations, the period necessary for runoff from the most remote portions of the district to reach the conduit and the cumulative quantities that would pass controlling points under the most critical conditions being computed.

At convenient points all water due to storms that exceed ¼-in. rainfall in 24 hr. is allowed to spill over long overflow weirs and directed through conduits to tidewater. The amount retained in the intercepting sewer is composed of storm water not in excess of the above specified amount, ground-water infiltration, and domestic sewage. Various allowances were made for ground-water infiltration, depending on locality and on the material of which the sewer is built. Usually 0.002 sec.-ft. per acre was assumed. The domestic sewage flow was computed on the basis of an average water consumption of

*Assistant City Engineers, City Hall, San Francisco, Calif.

70 gal. per person per 24 hr. This gives an average rate of flow of 0.109 cu.ft. per sec. per 1000 inhabitants. Assuming the maximum flow for short periods to be 50% in excess of the average, the rate for domestic sewage flow is taken at 0.163 cu.ft. per sec. per 1000 inhabitants.

Topographical Features

San Francisco is located at the northern extremity of a peninsula 35 miles in length. The city terminates on the west at the shore of the Pacific Ocean, and on the north and east it is bounded by San Francisco Bay. A spur of the Coast Range divides the area into two main drainage districts, one sloping toward the ocean on the west, the other toward the bay on the east. Many portions of the city being exceedingly hilly both these drainage areas are in turn subdivided. Previous to 1906 there were over 125 sewer outlets along the bay shore. By the recently constructed system the number discharging house sewage will ultimately be reduced to five, with provision for storm-relief outfalls as indicated on Fig. 1.

In determining points of outlet those locations were chosen at which, by reason of strong tidal currents, the maximum dilution of sewage would be obtained. Float observations were made near all of the points in question at flow, ebb and intermediate stages of the tide. It was proven that at the locations selected, when the outfall was extended far out into the bay, no offensive material would be washed back on the land.

As a general rule, the elevation of street surfaces along the water front is city base. Extreme high tide is 4 ft. below city base. Such a height occurs only at a rare combination of wind and flood. Ordinary extreme high tide is 5 ft. below city base and the intercepting sewers are designed to retain their flow without spilling over the weirs of relief outlets at this tidal elevation. Extreme low water is about 13 ft. below city base and inverts of outfall sewers at the bulkhead line are usually from 11 to 13 ft. below city base. As yet, no special devices have been installed at the outfalls, as none have been found necessary.

The ordinary tidal prism of the San Francisco Bay is 97,500,000,000 cu.ft., while the minimum flow from the tributary rivers in 7 hours (the duration of an average tidal outflow) is 2,500,000,000 cu.ft. This gives a minimum total flow through the Golden Gate of 100,000,000,000 cu.ft. in 7 hours. The ultimate maximum sewage flow from the municipal area of San Francisco is estimated at about 215 sec.-ft., which will be reached in 50 years.

Western Drainage Area

Along the ocean beach the breakers are always high and form at a considerable distance from shore. To construct an outfall beyond their influence would be impracticable, so the entire flow of the western drainage area is carried to the northern end of the peninsula through the Sunset District sewer. Storm water will be discharged near Mile Rock and in dry weather house sewage will be pumped from the main intercepting sewer to the Fort Point outfall, where it will empty at ebb tide far out in the channel. The lower portion of the storm sewer will be in tunnel for 4450 ft. Due to protracted litigation before a right-of-way for the outfall could be secured the upper sections were completed first. Work on the tunnel is now being rushed to completion.

For approximately a mile in the higher levels the course of the Sunset District Sewer lies within the drainage area of Lake Merced, whence San Francisco derives a portion of its domestic water-supply. The quality of the water from this source is by no means of the best and

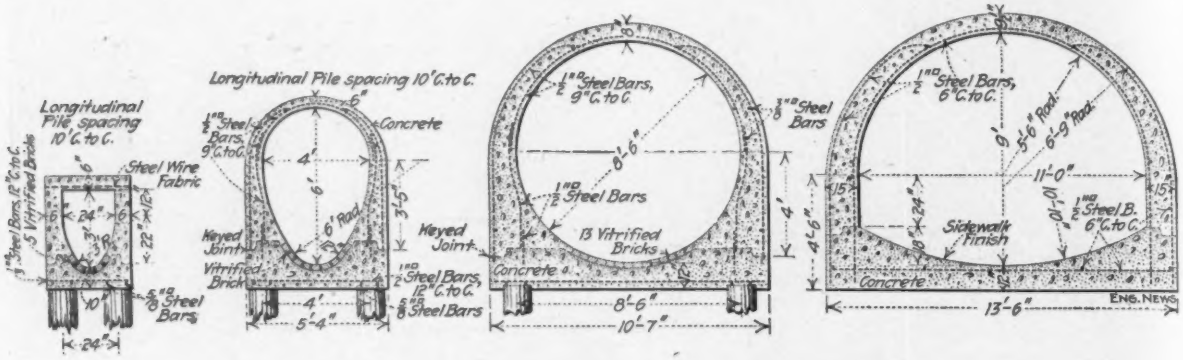


Fig. 2. Cross-Sections of Typical Sewers, San Francisco, Calif.

to guard against further pollution 24-in. cast-iron pipe with well calked lead joints was used for the sewer within the watershed.

The Sunset main varies in size from 24 in. in diameter to the largest section shown on Fig. 2. Originally it was planned to extend this conduit 1000 ft. from shore and discharge both storm and house sewage near Mile Rock. From the results of float observations taken near Mile Rock, it is evident that at flow tide the currents would carry suspended matter in an eddy toward the shore and into the harbor, while at ebb tide all of the sewage would be carried out to sea. Only one float out of the entire number dropped at ebb tide was washed back on the beach, but even after this demonstration the precaution was taken of diverting house sewage from this locality.

Eastern Drainage Area

In the low-level districts of the Eastern drainage area a separate system for house sewage was installed. Due to the necessity of providing drainage facilities for deep basements and a flow free from tidal influence, it was essential that sanitary sewers should be laid at considerable depths, the sewage directed by gravity to locations of minimum elevation and then raised by pumps into the

large high-level intercepting storm or combined sewers. Sanitary sewers were of salt-glazed, vitrified iron-stone pipe, and varied in dimensions from 8 to 20 in. In soft ground a pile foundation was provided and the pipe surrounded by reinforced concrete.

By far the greater portion of the city is provided with the combined system. Combined sewers constructed since 1906 are all of reinforced concrete, with a pile foundation wherever necessary to prevent settlement. The smallest size is a 2x3-ft. structure with egg-shaped invert and flat top, as shown in Fig. 2. The inverts of all concrete sewers were lined with vitrified brick in order to prevent scouring action.

In the eastern drainage area the largest combined sewer is the North Point main, which discharges into the bay opposite the foot of Sansome St. A district of nearly 12,000 acres, in which are the homes of over 80% of the population, is served by this sewer. Into it will also discharge three of the pumps by which the contents of the separate system are raised. When completed the North Point main will be approximately six miles in length.

FIG. 3. EQUALIZING CHAMBER IN TRIPLE-COMPARTMENT STORM SEWER

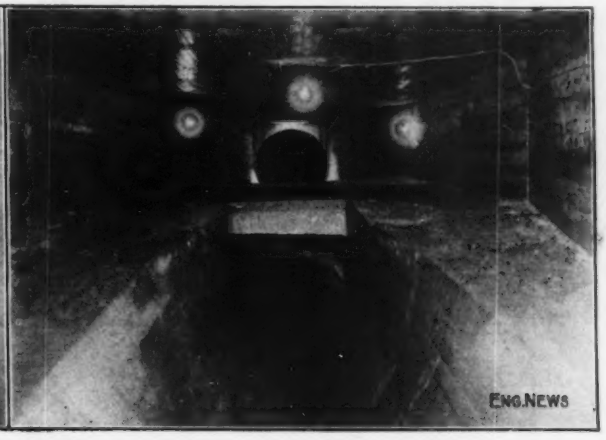


FIG. 4. OVERFLOW STRUCTURE FOR DIVERTING STORM WATER

When flowing quarter full over four miles will be of sufficient sectional area to admit of inspectors traversing it in a steam launch.

Besides the North Point main, the topography of the eastern drainage area rendered necessary two additional intercepting sewers. One drains the southern portion of the city and discharges at Hunter's Point; the second traverses the Panama Pacific Exposition grounds at the northern end of the city.

Both design and construction are now under the direction of M. M. O'Shaughnessy, City Engineer.

Wood Preservatives Used in 1913 by 93 wood-preserving plants, amounted to the following quantities: Over 108,000,000 gal. of creosote oil, 26,000,000 lb. dry zinc chloride, and nearly 4,000,000 gal. of other liquid preservatives. Over 153,000,000 cu.ft. of timber were treated by these plants, or about 23% more than in 1912. These are the figures given by the American Wood Preservers' Association in coöperation with the Forest Service of the Department of Agriculture, Washington, D. C. The report goes on to say that while in Great Britain and most of the European countries, practically all railway ties and telephone or telegraph poles receive preservative treatment, in the United States less than 30% of the 135,000,000 cross-ties annually consumed are treated, and that the proper treatment of an annual consumption of 4,000,000 poles may be said to have scarcely commenced.

Specification for a Non-Patented Bituminous-Macadam Pavement; Connecticut Highway Commission

The following specifications, drawn by Charles J. Bennett, State Highway Commissioner, of Connecticut, have resulted in a satisfactory bituminous macadam, or as some insist, a bituminous-concrete pavement. Being cold rolled, no elaborate apparatus is required for its construction and some of the work done under these specifications has been done by the state's own day-labor repair gangs:

QUALITY OF STONE

Unless otherwise specified, trap rock will be required. Only broken stone accepted by the Division Engineer will be allowed in the work. If trap rock is not required, the stone must be of a hard and compact texture and of a uniform grain. No disintegrated or rotten stone will be allowed. All stone shall be thoroughly clean before crushing and must be well screened, and free from injurious matter of every nature.

FIRST COURSE

SIZE—The broken stone for the first course shall be as nearly cubical as possible and shall consist of ¾-in. and ½-in. stone evenly mixed at the quarry or the run of the crushed up to ¾-in. stone without the dust.

BINDER—Texaco Macadam Binder or No. 161 Road Asphalt heated to a temperature of 300° F. shall be mixed with the stone using about 6½% of material by weight. The mixing may be done with a machine or by hand so long as properly proportioned and thoroughly mixed. This asphalt or binder shall be equal to sample submitted and shall be satisfactory in every respect to the State Highway Commissioner.

DEPTH—After the subgrade and roadbed have been made as specified a sufficient amount of this thoroughly incorporated aggregate shall be evenly spread thereon so that this course shall measure 2 in. in depth after rolling has been completed.

The stone shall be in a bone-dry condition, either naturally or having been dried out by the use of suitable heaters, if the weather is cold or moist and the stone damp. Under no circumstances, however, shall the stone be so hot as to cause the bitumen to fail to adhere to it in a coat of satisfactory thickness.

ROLLER—After the mixture has been spread for the first course, sufficient to roll down to 2 in. it shall be allowed to set for a period of at least two hours, and then a roller shall be run over the stone a sufficient number of times to form a firm and smooth surface of the proper cross-section. The wheels of the roller shall be oiled to prevent picking up the mixture in rolling. Should any unevenness or depressions appear during or after the rolling of this course, stone and bitumen shall be added to remove such uneveness or depressions.

SEAT COAT

ASPHALTIC BINDER—Immediately after the rolling of the first course a coating of Macadam Binder shall be applied, by pressure, to the surface in the amount of ¾ gal. per sq.yd. so as to completely fill all interstices and voids with the hot asphalt. The temperature at which this asphalt is applied shall be about 300° F. This macadam binder shall be equal to sample submitted and shall be satisfactory in every respect to the State Highway Commissioner.

SCREENINGS—Immediately after it has been spread, clean, dry, screenings, free from dust and sand shall be uniformly scattered over the surface and then rolled until the screenings are thoroughly embedded in the macadam binder of the seal coat.

ROLLING—The rolling shall be continued until the surface presents a smooth and finished appearance to the approval of the Division Engineer. Upon completion the road shall stand at least 12 hours before being opened for traffic.

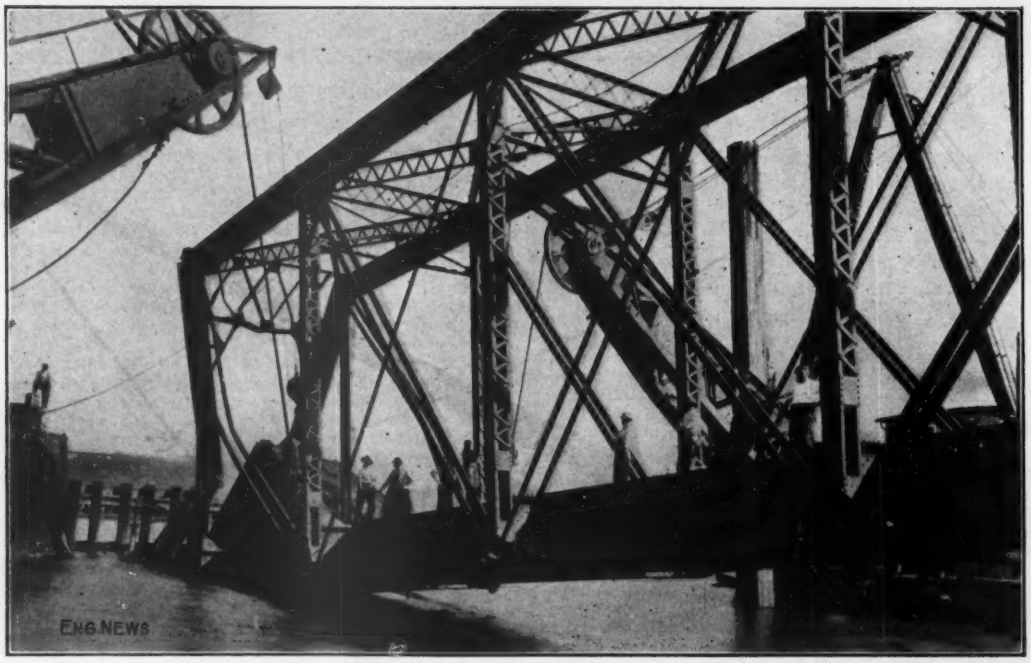
Raising and Repairing the Wrecked W. & L. E. R.R. Bridge over the Maumee River at Toledo, Ohio

By Edward U. Smith*

The wreck of one span of the Wheeling & Lake Erie R.R. bridge 2-A, over the Maumee River, at Toledo, Ohio, was noted in Engineering News, June 25, 1914. The span was 177 ft. instead of 150 ft. as stated.

It might be well to state that this particular span has

*Assistant Engineer in Charge of Bridges, Wheeling & Lake Erie R.R., Cleveland, Ohio.



Figs. 1-2. The Wrecked Span Being Raised by Two Great Lakes Dipper Dredges of 95-Tons Lifting Capacity Each

(Note the broken end post and portal.)

some back history, before describing the present accident and necessary repair work.

Prior History of the Bridge

Prior to the year 1896, this span was a wood-and-iron combination truss. It failed in 1895 while a heavy crane was crossing it, the crane and span both going into the river. A new steel span was built in 1896, designed for Cooper's E-35 loading and fabricated by the Toledo Bridge Works.

Pending the erection of the new steel span, piling was driven and frame bents set on top in order to carry traffic. On account of insufficient longitudinal bracing, these bents fell while a train was passing over, and several hopper cars were thrown into the river. The falsework was rebuilt with piling, omitting the frame bents.

In the year 1903, a boat failed to find the opening of the draw and hit this span, pushing it bodily into the river. On examination, the steel was found so badly damaged that it was necessary to build an entire new span. The new span, which was the one recently wrecked, was designed for Cooper's E-50 loading. It was fabricated by The American Bridge Co. and erected in 1904.

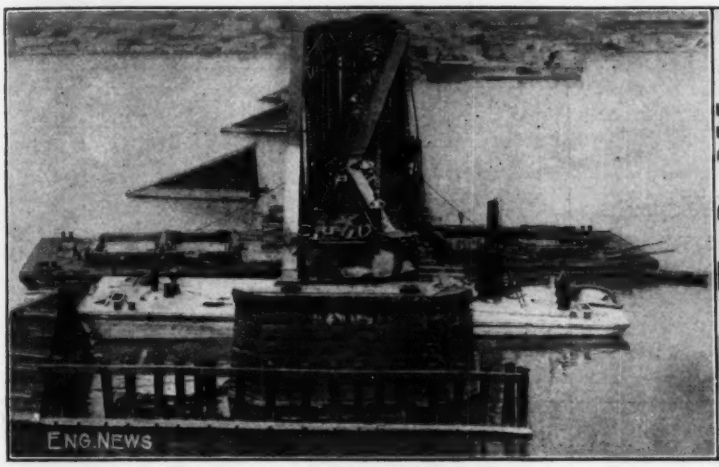


Fig. 3. Span Back in Place

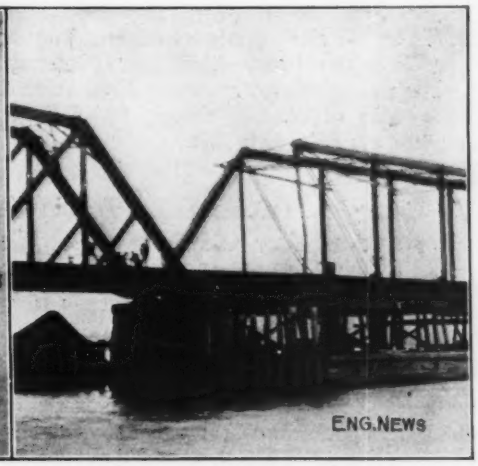


Fig. 4. Supported on Pile Bents and Broken End-Post Removed

Restoring Traffic over the Wrecked Bridge

The Latest Accident

The wreck of June 14, 1914, was a remarkable accident, in that very little damage was done to the colliding barge and comparatively little to the bridge, considering the fact that it was torn loose from the pier at its fixed end and this end fell on to old piling which surrounds the pier and had been cut off below the water line. These old piles prevented the span from going to the bottom. It did settle about 14 ft. under the water. The other end, which was the expansion end, remained on the pier and was thrust against the next span with such force that it tore its anchor bolts loose and damaged the stone masonry to such an extent that the top of the pier will have to be rebuilt. The steel in this span was not damaged.

Raising the Wrecked Span Back to Place

With the aid of two Great Lakes Dredge and Dock Co.'s dipper dredges, having a hoisting capacity of 95 tons each, we experienced considerable difficulty in getting the span loose from among the piles. Once it was started, however, it was an easy matter to raise the span up far enough to get two water-ballasted scows under it. As the span was raised, the scows were pulled over as close as possible to the pier and timber cribbing was placed under the span as the dredges raised it. A final raising, of a foot or so, required to bring the span to the proper elevation, was accomplished by pumping water out of the scows.

After the span was up to grade, a line was run to the scow from the dredge, and the span was swung into its true alignment, by towing the scows downstream. The expansion end, which had remained on the pier, was fastened back to the second span beyond by two 1½-in. wire cables, with ship-wrenches inserted to take up the slack as the span was raised. This precaution was taken to prevent the span from moving forward off the pier while being raised.

The damage to the span was found to be as follows, as will be seen in the pictures. The bow of the barge struck the end post and bottom chord, buckling them. This caused the portal, portal brackets and end floor-beam to buckle. The pin plates at the hip were sheared, allowing the end-post joint to open. The rest of the damage was caused by the impact with the piling.

The parts to be renewed were one end post, portal, portal brackets, two bottom chords for the first panel, one end floor-beam, one hanger, and two end stringers.

Restoring Traffic

To support the span and traffic while the new parts are being fabricated (by the American Bridge Co.), it was necessary to drive several pile bents. Using 55- and 60-ft. piles, single bents consisting of eight piles each, were driven, as nearly as possible under the first four panel-points of the wrecked span and the first two panel-points of the span next to the wrecked one. Single bents of eight piles each were driven on both sides of the damaged pier. One 24-in. 120-lb. Bethlehem girder I-beam

was placed under the posts, and one under each stringer of the second, third and fourth panels of the wrecked span, oak wedges being used to obtain a full bearing of the floor-beams on the I-beams. The end panel of this span, from which the damaged stringers were removed, is being carried on eight 9x18-in. yellow-pine stringers. The second and third floor-beams of the other span were simply blocked up on the pile bents.

In order to temporarily support the ends of the two spans over the damaged pier and to provide for the repair of the pier without further interruption of traffic, four 24-in. 83-lb. Bethlehem I-beams, 24 ft. long, were placed on the two eight-pile bents, immediately under each shoe. These 8 I-beams will be left in position and four 24-in. I-beams 8 ft. long, placed longitudinally, with a tranverse grillage of 60-lb. rails, on the pier under each shoe to make up the depth of 52¼ in., the depth to which the top of the pier was removed. The pier will be capped with concrete and the ends of the 24-ft. I-beams will be cut off with an acetylene torch.

The wreck of this bridge occurred about 8:30 a.m., June 14, and the bridge was reopened to traffic on June 27. The new steel members have been fabricated and are now being placed in position without interrupting traffic.

The raising of this span was done under the personal supervision of W. L. Rohbock, Chief Engineer of the Wheeling & Lake Erie R.R.

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A Large National Water-Works System for Cities and Towns in Southern Italy

By John C. Trautwine, Jr.*

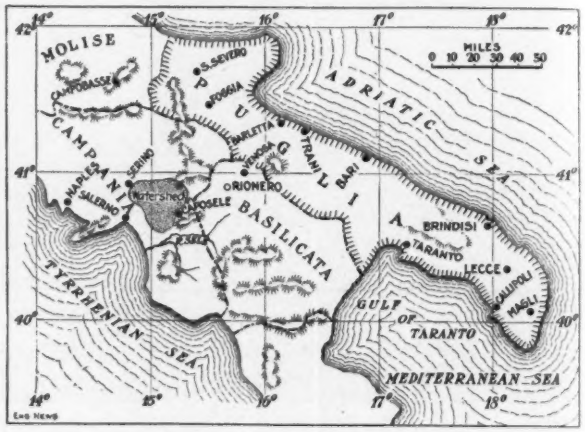
To supply water for domestic consumption and public purposes to 3,000,000 people living in cities and towns in an arid section of 8000 sq.mi. in southeastern Italy, the Italian government, through a franchise contractor, is carrying water through the Appenines from western Italy by means of a long aqueduct and a network of cast-iron pipe, the whole of the conduits totaling about 1900 miles. Hydro-electric-power and water-power plants developed by the fall of water through the aqueduct, together with Diesel oil engines where aqueduct power is not available, will pump a large part of the water to cities and towns 200 to 700 ft. above the main conduits. The use of some 400 Venturi meters, a universal consumer's meter system, and the purchase of a large quantity of American pipe add to the interest of the works, which, with the reasons for their construction, are here briefly described.

Along the Eastern or Adriatic coast of southern Italy stretches a district, about 200 miles long, from northwest to southeast, and of a nearly uniform breadth of about 40 miles (see map). This district (once the Duchy of Apulia, or Puglia) comprises the three provinces of Foggia, Bari and Lecce. Its population is about 3,000,000.

The district is of a cavernous limestone formation, with very little ground cover, and is practically without fresh ground water. Wells yield only brackish water; and the few and small streams are generally dry in summer. The country is therefore dependent upon rain water, caught in cisterns. In 1908, from March to October, no rain fell, and the Government, during more than two months, was forced to send fresh water, for the relief of the 3,000,000 inhabitants, by railway and in war vessels.

In October, 1906, the Italian government began the construction of a gigantic water-supply system for the permanent relief of the people of Puglia. Eastward from Naples lies the watershed, an elevated district of dolomitic limestone, underlaid with clay, with an area of some 600 sq.mi., and with elevations of from 4000 to 6000 ft. above sea level. The rain falling upon this district finds outlet at only three points. One of these is the Serino source of the Naples water-supply; a second is being developed for the supply of Salerno, 30 miles east of Naples; and the third is the source of the River Sele, which is being used for the supply under consideration.

The Sele issues from the southeastern side of the district, in a spring, at Caposele, having an elevation, above sea, of about 700 ft., and flows into the Tyrrhenian Sea about 20 miles south of Salerno. The flow here is about 115,000,000 gal. per day, and is exceedingly constant; a little greater than normal in summer (when most needed), owing to melting snow. In the near neighborhood are three smaller springs, to be utilized eventually. They will increase the supply to about 150,000,000 gal.



Map Showing Location of the Puglia Water-Supply District, Italy

(Water, naturally flowing westward into the Tyrrhenian Sea, will be diverted from the headwaters of the River Sele, and carried eastward, by tunnel, through the Appenines, to the arid district of Puglia, on the Adriatic Sea.)

daily; for which quantity the works are designed. The water issues from this spring at a temperature of 48° F., and in order to maintain this low temperature, all pipes and conduits are required to be laid not less than 3 m. (say 10 ft.) below the surface; all reservoirs have a cover of the same depth; and any conduits, which, for any reason, cannot be given the prescribed 3-m. cover, are protected by air jackets about 8 in. wide.

The water of the entire district is of exceptional purity; so that no filtration, or other purifying process, is required. The Sele supply, moreover, is carefully protected against accidental or malicious defilement. The water furnished to Naples (notwithstanding its limestone source) is entirely soft, while the Sele supply is a trifle hard.

The natural basin, which forms the Sele spring, has been filled with loose broken stone, and roofed over, with the specified cover of 3 m., of reinforced concrete and earth.

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Here begins the aqueduct, which has here an ovoidal section of about 72 sq.ft., and a downgrade of 1:4000, which, with a few exceptions, is maintained throughout the entire length, between those points where water-power is utilized, as described below. The object of using the flat slope of 1:4000, is mainly to conserve the head for power purposes, at the expense of a larger cross-section than would have been sufficient with a steeper fall and higher velocities. The aqueduct will run nearly full. Except in the siphons, it is nowhere under pressure.

From the source, at Caposele, the aqueduct extends northeastwardly, passing to the south of Rionero and Venosa. West of Venosa branches off the line extending northward to S. Severo (the northern end of the system) and supplying Foggia, the northwesternmost of the three provinces constituting Puglia. Southeastwardly, the distribution extends to Cape S. Maria di Leuca, at the extreme end of the supply district.

The passage of the Appenines is effected by means of a series of tunnels, covered conduits, aqueduct bridges and inverted siphons.

Of the total length, 60 miles are in tunnel. Six of the tunnels have an aggregate length of 36 mi.; and, of these, one is 12 mi. long, or as long as the Simplon tunnel. The small section of these tunnels, and their down grade, of course added to the difficulty of their construction.

Some of the tunneling work has been of exceptional difficulty. In the first tunnel driven (over 9 mi. in length), the contractors encountered a plastic black clay, which swelled greatly when moistened. In the headings, close timbering, of 14-in. round logs, was bent inward, and the ends of the posts were driven bodily into the caps and sills, indicating a pressure far in excess of that due to the greatest height above the work, and suggesting an internal force due to the expansion of the material, caused by moisture. In this material, 1 to 3 ft. per day was the maximum rate of advance.

The last piece of tunneling, that at Croce del Monaco, has just been finished, after being greatly delayed by quicksands.

The siphons are of brazed steel pipes, in pairs, and in general with leaded bell-and-spigot joints, and incased in concrete.

The profile of the conduit consists of slopes, generally of 1:4000 (as already mentioned) separated by steeper slopes, from which water power is derived. The power is utilized, mostly by means of electrical transmission, in pumping from the conduit to the several towns, most of which are situated upon elevated sites, from 200 to 700 ft. above conduit level. In some cases turbines are directly connected with the pumps. Where water-power is not available, Diesel motors are used. All pumping stations are in duplicate, as a precaution against accident.

In the three provinces to be supplied, there are at present no villages, and even the farming population resides in the towns and cities; the farm workers walking (often many miles) to and from their work. This results from malaria, which infests the low lands, driving the inhabitants to the towns upon the hills; and from the fact that, formerly, the district was subject to incursions from warlike neighbors, who crossed the narrow seas which separate this part of Italy from its surroundings.

It is, however, provided, by law, that water is to be furnished, from the works described, to any who may wish to settle in its neighborhood, and it is believed that this, together with changed political conditions, and the general sanitation of the low lands, will conduce to the establishment of villages and small towns, and the creation of a rural population.

Construction

The work is being constructed by the Societá anonima Italiana Concessionaria dell' Acquedotto Pugliese-Genova (President, Senatore Giovanni Bombrini) under contract with the Italian government, the terms of which are fixed by a special law. Under this contract, the company receives 124,000,000 lire ($24,800,000), which will be largely exceeded by the cost of the work; but the company is given also the entire earnings of the works for a period of 90 years from their construction.

Not less than 400 Venturi meters are to be installed on the work, for the large-scale measurement of the water.

By the terms of its contract, the company is bound to supply each town with public fountains, in number proportional to the number of inhabitants. All other water, for both public and private use, is to be sold by meter, at sliding-scale prices, fixed by law.

With 3,000,000 population, and an eventual supply of 150,000,000 gal. per day, the per capita daily consumption will be 50 gal.

The cities of Puglia are as yet without sewerage systems. With the construction of sewers, the consumption of water may be expected to exceed the capacity of the works here described.

The company is required to furnish water only for domestic and public consumption (the latter only for public buildings, schools, etc., not for boiler use or for irrigation). The company has the privilege of furnishing water for other uses; but this is not contemplated for the near future. A project for irrigation, using another source, is now under study by the Italian government.

For each town, the company is required to construct a covered reservoir, holding not less than two days' supply.

The water is to be pumped to the elevated towns, from the aqueduct, through cast-iron pipes, with bell-and-spigot lead joints, requiring a total of about 120,000 tons of pipe. American industry is reaping some benefit from this work, the water company having contracted with R. D. Wood & Co., of Philadelphia, for the supply of about one-third of the cast-iron pipe required.

On an average, about 10,000 men have been employed upon this work for eight years.

The total length of conduits and piping will be about 3000 kilometers, or 1900 miles.

For the data here given I am indebted to Sig. Carlo di Chiusano, engineer to the contracting company, which he served chiefly in connection with its tunneling work. Sig. di Chiusano is now in America, looking after the execution of his company's pipe contracts.

A Pavement Problem in Reading, Penn., has grown out of an old court decision that the city authorities cannot assess abutting property owners for the cost of repaving macadamized streets with uptodate pavements. The streets being held to be already paved must be improved at the expense of the city as a whole. Of its 80 miles of paved streets Reading has about 60 miles surfaced with macadam, so the problem is a large one, and it has recently been studied by the Bureau of Municipal Research of New York City.

Tar-Formation Temperatures for American Coals

One of the troublesome points in the better utilization of miscellaneous American coals is the formation of tars; therefore, a recent investigation, which gives information on (1) the temperature limits of tar formation; (2) the temperatures of maximum evolution, and (3) the relative quantities evolved from various coals, is of wide interest and importance. This study was made by O. C. Berry while Assistant in Steam Engineering at the University of Wisconsin (and is being continued at Purdue University where he is Instructor in Mechanical Engineering). The following brief report is based on a detailed statement forming Bulletin No. 635, University of Wisconsin (Engineering Series, Vol. 7, No. 7).

When bituminous coal is fired in a boiler furnace, the volatile constituents are driven off at a comparatively low temperature and appear above the fuel bed. If the air supply, over grates, is insufficient or cold or if the volatile matter is chilled by cool parts of the boiler, carbon is deposited as soot or floats out as more or less dense smoke. The practical problem is to cause the volatile gases, carbon monoxide and tar vapors to mix with high-temperature air; a better knowledge of the temperatures at which tars distill and the rates at various temperatures then is of material aid in designing furnaces and grates and facilities for the best firing of the coal.

In coke manufacture, with the rise of byproduct processes, this same information is of service. Perhaps the most important field for its application, however, is in bituminous gas-producer work; tar vapors are particularly troublesome here, for if carried over to the gas engines, they clog up the pipes and valves. Complete separation of tar is difficult and more or less expensive. Attempts have been made to burn the tar and to "crack" it up into fixed gases.

Tar-formation temperatures have to be considered in such efforts—as for instance if air is introduced to unite with the tar at the last point where it is evolved in the fuel column, this point is determined by the temperature. In the scheme of drawing tar vapors off the top of the fuel column, introducing them under the grates and drawing tar-free gas off at the center height, such knowledge as mentioned is essential in securing good gas without excessive heat losses.

In the studies undertaken, furnace conditions were similated but with such apparatus as afforded good control. It was desired (1) to heat the coal slowly and at a uniform rate; (2) to conduct the heat to the center of the coal body by good conductors; (3) to know the coal temperature at all times; (4) to sweep out the evolved gases as rapidly as formed; (5) to cool down the gases and continuously test for tar; (6) to prevent low-temperature deposition in the pipes and later high-temperature redistillation.

The furnace was a special resistance-coil design. The coal was held in a cartridge, 2½ in. in diameter with small inlet and discharge pipes for blowing inert gas through, and with a thermometer well. To transmit the heat to the interior, perforated iron disks were packed with the coal ¼ in. apart. The sweeping-out gas was air with the oxygen burned out, furnished under pressure and at full furnace temperature. To test for tar a small stream of the gases direct from the cartridge was chilled and caused to impinge at high velocity on a paper ribbon. If there is any trace of tar it is deposited on the paper; Not quite all the tar evolved is secured owing to the rebound of the smallest and lightest of the tar particles; however, the deposit probably is nearly proportional to the entire tar content. To prevent redistillation, the pipe leading out of the cartridge was changed every 5 to 10 min., there being plenty of duplicates.

A study of the tests and results leads to several generalizations:

(1) Tars begin to distill from any grade of bituminous coal or lignite at some 300° C.

(2) Maximum evolution is between 375° and 475° C.

(3) Tars have been all evolved on reaching a temperature of 550° C. usually, though 600° is obtained for a few coals.

(4) Formation *temperatures* are not dependent on the geological age of a coal, amount of volatile matter, or carbon-hydrogen ratio in the class tested; tars may appear or disappear at approximately the above temperature with any grade of American bituminous coals.

(5) No relation is evident between evolved tar and amount of volatile matter in the coal.

(6) A distinct relation is seen between *amounts* of tar evolved and the carbon-hydrogen ratio. Maximum amounts of thick tar came from coals with this ratio ranging from 13.5 to 18; knowing the carbon-hydrogen ratio of two coals and the tar evolution of one, the yield can be predicted with considerable accuracy for the other.

(7) The volatile matter of Western coals contains fixed gases and watery vapors of low calorific value—shown by small amounts of tar deposited but low-heating value of coal.

The specific data for 11 typical coals is given in the accompanying table.

TAR-FORMATION TEMPERATURES OF AMERICAN COALS

Coal	Geological age	Carbon-hydrogen ratio	Volatile matter; per cent.	Tar starts; deg. C.	Temp's. max. tar deposit; deg. C.	Tar ceases; deg. C.	Per cent. of sample deposited on paper	Per cent. of volatile matter deposited as tar	Heating value "unit coal"
Pocahontas	Carboniferous	19.1	17.95	320	420 to 475	560	0.177	0.988	16,090
Youghiogheny	Carboniferous	15.8	33.13	280	370 to 540	600	1.705	5.16	15,787
Carterville	Carboniferous	15.3	31.34	300	380 to 460	520	.....	.....	14,820
Iowa No. 1	Carboniferous	13.4	36.63	260 260	360 to 480 350 to 475	540 535	0.805	2.194	14,949
Kentucky No. 2	Carboniferous	12.7	37.96	375	380 to 620	655	0.351	0.923	14,918
Indiana No. 2	Carboniferous	12.3	41.75	295 300	370 to 420 390 to 430	545 560	0.55	1.32	14,780
Illinois No. 1	Carboniferous	12.2	39.24	280 275	370 to 435 350 to 475	580 575	.....	.....	14,643
Wyoming No. 2	Creataceous	12.2	37.68	300 300	380 to 490 365 to 480	520 525	0.422	1.122	14,542
Iowa No. 5	Carboniferous	11.2	38.59	280	345 to 440	525	0.332	0.86	14,531
New Mexico No. 2	Cretaceous	11.2	36.29	312 318	380 to 450 385 to 460	525 520	0.234	0.64	14,350
Colorado No. 1	Cretaceous	10.6	32.95	270 270	375 to 400 350 to 405	500 515	0.180	0.573	13,523

*Parr and Wheeler, Univ. Ill. Bull. 37. B.t.u. — 5000 S + 1.00 — (1.08 ash + $\frac{1}{18}$)

Editorials

A Mileage Charge to Owners of Motor Omnibuses to Pay for Road Repairs

The injury done to road surfaces by heavy motor trucks and motor omnibuses is beginning to be talked about by engineers in this country. It has hardly come as yet to the notice of the taxpayers, who pay the money to maintain the roads, a possible reason for which is that in a large proportion of the States the roads are not maintained in the proper sense of the word. and are allowed to be practically destroyed after construction before anything is done about it.

In England, however, the problem of making the owner of the motor vehicle pay for the damage he does to the roads he uses is already a question of practical politics. The London *Surveyor* states that on July 1, the Local Legislation Committee of Parliament considered the question of the contributions owners of motor busses should make to pay for road maintenance. The City of Sheffield desired authority to run motor omnibuses outside the city limits into adjacent counties. The county authorities opposed the granting of the privilege unless the City of Sheffield would pay enough for road maintenance to cover the resulting wear and tear. The Committee finally granted permission to operate four of the seven routes desired, on condition that the City of Sheffield would pay the counties ¾c. per car mile for all mileage traveled by its motor omnibuses within the county limits, this rate of payment to be subject to revision every three years.

The Chairman of the Committee also announced that a general act would probably be brought forward in Parliament, fixing a rule to apply to the whole country, as to the amount to be paid toward road maintenance by operators of heavy motor vehicles. It should be remembered in this connection that Great Britain already assesses a heavy license tax on all motor vehicles, graded according to the weight and power of the vehicle, the proceeds of which are devoted to road construction and maintenance under the National Road Board. The proposed special charge to users of heavy motor trucks and motor omnibuses is in addition, therefore, to the heavy tax already laid. The almost universal testimony of English road engineers is that this additional tax is a necessity to fairly repay the added cost of road maintenance due to these heavy high-speed vehicles.

Reducing Casualties on Construction Work

New York's new Employer's Liability Law, which went into effect on July 1, should bring about a reduction in the number of men injured on construction jobs. This result will not be realized at once. Employers must first appreciate the full measure of the added responsibility. On the first day of the new law, on a large building contract in New York City, one man was killed and three others injured by falling material. There have been other casualties on this same job from this same cause.

The dropping of objects constitutes one of the greatest hazards of building construction. This hazard increases with the area and distribution of the work; it is obvious that the dangers from this source are greater, for instance, at the Equitable Building, the largest office building in the world in point of floor area, than on some 20-story loft building or apartment house uptown, all other factors equal.

Other factors contributing toward the construction hazard are: the number of floors upon which work is in progress simultaneously; character of the work; speed of its prosecution; skill and intelligence of the workmen, and the vigilance and efficiency of the man in charge. The last two factors are especially important; mechanical safeguards can prevent but a small proportion of accidents where reckless methods are permitted. Coöperation between employer and employee, foremen and men, is absolutely necessary if the irreducible minimum of accidents is to be attained and maintained.

Careless handling of materials and defective plant equipment are going to cost employers a lot of money under the new law; and the sooner this is appreciated, the better for all concerned. Most failures of handling equipment can be traced directly to lax plant inspection.

On a big construction contract where the responsibilities of the superintendent are too great and too pressing to permit him to personally acquaint himself with the condition of scaffolds and other falsework, derrick guys and cables, loads on tools, and methods of hoisting and piling material, it would be economy to place a competent man in charge of these details. Saving one man from death or serious injury might pay the salary of such a "Safety Man" for a year or for several years. When subforemen are held accountable for accidents, the result is usually divided responsibility. The duties of subforemen frequently overlap, when, of course, "nobody is to blame."

It must be frankly accepted that the most efficient method of prosecuting work is not always the safest. For instance, blasting can be carried on with comparative safety, but the work does not progress fast enough; it costs too much. In blasting for the foundation of a well known metropolitan skyscraper in a thickly populated district, a rock as big as a man's head was thrown two blocks, dropping into a large railway terminal. This was not "safety first."

There are conditions which demand speed even at the cost of inconvenience to the public; prohibitive financial loss to the contractor, etc. In such cases, the work should be pushed with the greatest speed commensurate with reasonable safety and with the maximum safety possible with that rate of prosecution.

Temporary coverings, floors, or "butterflies" of wood or corrugated metal should be built where practicable in new buildings to prevent tools, brick, tile and other small objects from falling through open space and striking men

working below. This sort of protection is required over sidewalks in most large cities. If the idea were followed up inside the buildings, fewer broken heads would be recorded. Such protection is especially desirable on wrecking operations.

The use of chains is diminishing and wire cables are being substituted where possible. Careful inspection often fails to discover weak links, but broken strands are readily detected. Mechanical safety devices in the form of safety grips on derrick or crane hooks, covered gears and boxed-in conveyors and hoists, etc., should be insisted upon.

The best way to stop abuses, nuisances, incompetent or slip-shod methods, is to give them publicity. If all the accidents which occur in the building construction of a large city were recorded and published, safer methods would be used. From analysis of such statistics, causes of accidents would be revealed and met where possible with remedies. Contractors, who have to bear the expense of accidents occurring on construction work, would undoubtedly be glad to accept authoritative and practical recommendations for better practice.

Who Owns the Pennsylvania Railroad?

There s a widespread popular impression that the great railway and industrial corporations of the country, with their many millions of dollars of capital, are owned by a few wealthy individuals, and that legislative attacks upon them tending to destroy the value of their property will injure nobody except people who have already more money than is good for them. Nothing could be further from the truth.

We had occasion not long ago to carefully examine the list of stockholders of one of the great manufacturing combinations, a concern which is undoubtedly a "trust" in the popular acceptation of that term, and which has some $50,000,000 in common and preferred stock outstanding. It was little short of amazing to find how widely distributed was the stock of this company and what a large proportion of it was in small holdings, owned by persons scattered all over the United States. No single stockholder, as we recall, held over half a million dollars' worth of the stock and there were very few who held over $100,000. There was an enormous number of small stockholders with lots of five, ten, twenty or thirty shares.

We have not the accurate figures at hand as to the actual distribution of the stock in that trust, but we are able to give figures for the distribution in a far larger corporation, the Pennsylvania Railroad Company. According to figures just made public, the stock of the Pennsylvania R.R. Co. is now held by 89,844 people, of whom 44,319 are women. The tendency toward a wider distribution of stock is shown by the fact that the number of stockholders increased over 8000 in the past year, and the average number of shares per stockholder dropped from 119 shares to 111 shares. The women stockholders hold, on the average, 64 shares apiece. As the Pennsylvania R.R. stock has a par value of $50, this means that the average Pennsylvania stockholder owns $5550 worth of stock, and the average woman stockholder holding Pennsylvania R.R. shares owns $3200 worth of stock par value.

One occasionally hears the claim made that the Pennsylvania R.R. is owned by foreigners. While it is true that there are many stockholders of the Pennsylvania and other large investment corporations resident in foreign countries, the great bulk of the stock is held in the United States. According to a summary made on May 31, a third of the Pennsylvania R.R. stockholders, or 30,463, live in Pennsylvania; half as many more, or 15,350, in New York; 16,536 in New England, and 11,803 in foreign countries.

But in answering the question, who owns the Pennsylvania R.R., we cannot consider its 90,000 stockholders alone. Suppose the influences which are seeking to destroy all property values, and especially those held by corporations shall be finally successful, so that a great corporation like the Pennsylvania R.R. will be compelled to steadily increase its expenses by paying higher wages to labor, etc., while at the same time its earnings steadily decrease until it can only pay its operating expenses, leaving nothing for dividends to stockholders or interest on its bonds.

It would not be merely the 90,000 stockholders of Pennsylvania R.R. stock scattered all over the country who would suffer loss as the result of such a campaign. The number of people who would lose by such a calamity would be numbered in the millions. They would include beside the 90,000 holders of Pennsylvania R.R. stock, the many thousands of holders of stock in other corporations which are affiliated with the Pennsylvania R.R. system and operated in connection with it.

But the stockholders after all are few in number compared with those who have an interest in the bonds issued by the company. The various bond issues of the Pennsylvania and its affiliated companies amounting to something like $300,000,000 are very largely held by savings banks and life-insurance companies, scattered all over the country. These bonds represent the accumulated savings of millions of men and women, working for wages, who have laboriously saved their earnings to provide for illness or old age. A campaign to annihilate property values could not be carried very far before a host of savings banks and life-insurance companies would have to suspend payments. Then would follow the appointment of receivers and in too many cases the dissipation of the remaining assets among a horde of hungry lawyers and political sharks.

The wide distribution of ownership in the Pennsylvania Railroad typifies the ownership of every other great railway and industrial corporation and is of interest also in connection with the currrent discussion respecting government ownership of railways.

The underlying idea in a large part of the agitation for government ownership is that the railways are now owned by a few individuals of enormous wealth, who are rapidly growing richer from the dividends and interest payments, whereas if the railways were taken over by the government, the government itself would hold all the stocks and bonds and would receive all the profits. But as the above discussion shows, the railways of the country are owned not by a few thousand wealthy individuals, but by millions of people who work for their living. The government could not and will not, until the forces of anarchy are triumphant, destroy the property belonging to all

these people and forcibly take it away from them. If we are to have government ownership of railways, it can only come about by the government buying the railways from the stock- and bondholders and paying for them in promises; or, in other words, government bonds. This would simply mean that the millions of people who now hold railway stocks and bonds would hold government bonds instead, and the government itself would be obliged to pay the interest on these bonds or go bankrupt, whether the railways earned profits enough to pay the interest or not.

If anyone believes that under government ownership the railways would be more efficiently and economically and honestly managed than they are now by their present officers under the supervision of State and Federal authorities—if anyone really believes this proposition, we suggest a careful study of our recent editorial wherein we reviewed what the government actually does in spending money on river and harbor improvements.

Until the United States government is administered with enough wisdom to stop spending many millions of dollars a year on works for inland navigation which are of no possible benefit to anybody, it would be the height of foolishness to place upon Congress the additional responsibility of directing the operation of the country's railways.

Laying Sewer Pipe with Water-Tight Joints

In our last week's issue we published a very interesting and carefully prepared article by J. M. Begg, Assistant City Engineer of Edmonton, Alberta, describing the methods which have been adopted in his practice in laying cement sewer-pipe joints so as to produce a water-tight line.

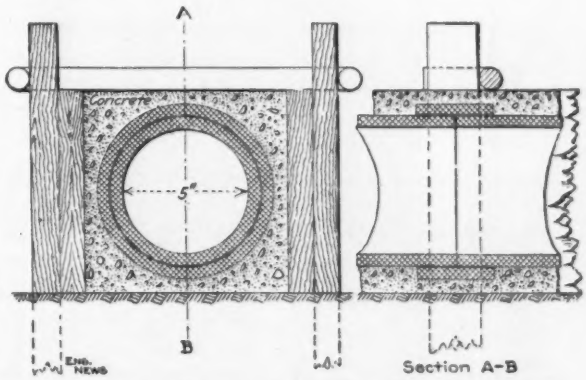
We wish to call special attention to Mr. Begg's paper in connection with the editorial suggestion on p. 1138 of our issue of May 21, in which we proposed to substitute in place of the present difficult and uncertain method of attempting to fill the joints of vitrified pipe with cement paste, the plan of surrounding the whole pipe with concrete. We discussed briefly the possibilities of this plan in the editorial referred to, but we wish to recur to it again and study its advantages farther, in connection with the statements made by Mr. Begg.

In laying sewer pipe by the suggested plan, when the bottom of the trench is finished to grade, two lines of boards would be set up on the bottom of the trench, the width between them being two or three inches greater than the diameter of the vitrified pipe to be laid, and held in position by stakes and clamps. Next, concrete would be deposited between these boards to a depth of two or three inches, and then the pipe would be laid and slightly bedded in the concrete. Next, concrete would be filled in on both sides and on top of the pipe, flush with the top of the boards, and slightly tamped or smoothed off to make the whole solid. When the concrete had set, the boards would be removed, ready for use on the next job.

The accompanying sketch shows sections of such a concrete-embedded pipe. In a sewer lateral of 5-in. outside diameter, embedded in a 7-in. square line of concrete, the cross-section of the concrete would be in the neighborhood of 30 sq.in., at which rate a cubic yard of concrete would be sufficient for nearly 135 lin.ft. of pipe. Assuming a cost of $5.50 for the concrete, which should be made, of course, with fine stone or gravel aggregate, the total cost would amount to only about 4c. per lin.ft. of pipe laid.

It should be worth very much more than this sum in any sewerage system to thoroughly secure the laterals throughout the system from the infiltration of ground water, to say nothing of eliminating the annoyance often caused by the penetration of tree roots into the sewers through defective joints. The cost of the concrete, however, would be largely offset by the saving of the expense of making and inspecting the sewer-pipe joints in the ordinary manner, as described in Mr. Begg's article.

As some of our readers may recall, R. H. Peck, of Palmerton, Penn., in ENGINEERING NEWS of June 4, declared that his trouble in getting water-tight joints in sewer work was so great that a rule had been established under which this work was done throughout the entire city by one experienced and reliable foreman. The difficulties presented when such an indispensable man takes a vacation, has a period of illness, or goes on a strike, are obvious.



A PLAN FOR LAYING SEWER PIPES IN CONCRETE

It is well to emphasize further that any method of sewer-pipe jointing now in use does not, after all, secure a water-tight pipe. Mr. Begg himself, in referring to his method, says: "It is an attempt to work out a method which, taking full account of human nature and the actual conditions of pipe laying, should reduce the danger of leaky joints to a minimum."

As every engineer experienced in sewage-disposal work is aware, tests of sewerage systems laid according to the specifications of the best engineers, and in the most thorough and conscientious manner, have shown that notwithstanding all the care taken, ground water to the amount of many thousands of gallons daily percolates into the pipes.

Nor is this the only difficulty experienced from the present methods of making sewer-pipe joints. As Mr. Beggs points out, a very little carelessness on the part of the workmen will produce joints of an uneven thickness, pipes with an uneven grade, and projections of cement inside the pipe which, if they do not cause clogging, form little dams in which standing sewage collects, increasing the septic action, and the bad odors in the pipes.

All these difficulties should be obviated by the plan we have here suggested, of bedding the pipes in solid concrete. While the cement mortar in the concrete would

work into the joint to some extent, sufficiently to hold the pipes solidly and firmly in place, it would hardly creep so far as to enter the pipe itself. If it were found with very wet concrete that any trouble of this sort was experienced, it would be an easy matter to pull a bag through the pipe before the cement set, as is often done to avoid trouble with cement joints laid in the ordinary way.

As we pointed out in our recent editorial, the possible usefulness of the suggestion we have made is not confined to the sewer laterals only 4 to 6 in. in diameter on private property. It should be equally advantageous to apply the same system to the laying of street sewers up to a diameter of at least 12 in. While the amount of concrete required would be considerably larger, it would still be a very small percentage of the total cost involved; and besides the water-tightness secured thereby, the protection of the sewer from injury by workmen engaged in other street excavations is an advantage of no small importance.

Still further, if engineers in considerable numbers were to adopt this method of laying sewer pipe in sizes up to say 12 in. in diameter, it would doubtless lead to a reduction in the cost of the pipe, which would at least partially offset the cost of the concrete in which it was laid. It is probable that straight lengths of sewer pipe without the bell and with plain collars to cover the joints in place of the bell, could be manufactured at a materially lower cost than the present form of pipe. Such straight pipes could be piled and transported with much less loss by breakage. It is the projecting bells in a pile of sewer pipes that generally suffer when breakage occurs.

Such straight lengths of pipe, laid with collars, would eliminate any possible question as to the water-tightness of the construction described. It will be admitted, doubtless, that any water which enters a line of glazed sewer pipe must enter through the joints. In order to enter the joints of a concrete-embedded pipe it must percolate through a considerable thickness of concrete, and with closely fitting collars instead of bells for the joints, the cross-sections of concrete through which percolation could occur would be so exceedingly small as to eliminate almost the last possibility of leakage.

We trust that some of our readers engaged in this field of work will try out the system above suggested and report results.

Letters to the Editor

Narrow Tires as Road Destroyers.

Sir—Some years ago you said that I exaggerated greatly the effect of bad wheels—narrow tires—on macadam roads. Did you notice that a year or two ago the Massachusetts Highway Commission confirmed me? At least I understand that the Commission has reported that it is heavy loads on narrow tires that causes damage, not motor vehicles.

Of course the Commission should have known what a road—what a wheel—is without being shown; but after all their worst error is in not seeing that *light loads on narrow tires* are cutting out their general problem for them.

I believe that if you had properly reported this discovery, Governor Glynn, of New York State, might not have fallen into (or might have fallen out of) the error of saying recently that, in Massachusetts, experience showed that the automobile is the worst vehicle for wear on roads!

I do not think so much of your claims to be for conservation since you fail so utterly to urge the conservation (from wanton destruction) of our most important, our fundamental, natural resource, our natural highways—and equally horses and vehicles.

We are trying to build good roads for bad wheels! How miserably we fail to get them good is shown best by the test discovered by me among the Missouri experiment-station trials. Collecting and averaging the trials in Bulletin No. 39, I found these remarkable results:

6-in. tires on earth roads, average lb. pull per ton, 61 = 100%.

1½-in. tires on earth roads, average lb. pull per ton, 86 = 141%.

1½-in. tires on macadam roads, average lb. pull per ton, 71 = 116%.

6-in. tires on macadam rads, average lb. pull per ton, 55 = 90%.

Just think of our fool investment in rolling stock which constantly produces in roads and vehicles, and requires from horses, 41% excess pull per ton on earth roads and 30% extra on macadam and gravel roads. I can't see why you keep mum so absolutely as to what great things good wheels would do. If a hint to the wise is sufficient, this should be ample for you, but, alas, there is none wise as to roads!

J. M. HEISKELL.

1107 S. Cooper St., Memphis, Tenn.,
June 29, 1914.

The Proportional-Flow Weir Devised in 1896

Sir—Herewith I hand you a copy of Vol. I, No. 1, of the *Transactions* of the Nebraska Engineering Society, published in 1897. On p. 13 you will find an article by me entitled "A New Form of Weir Notch." I am unable to see that the article entitled "A Proportional-Flow Weir," appearing on p. 1409 of ENGINEERING NEWS, of June 25, 1914, goes beyond this.

The same problem was worked out independently at a later date by Prof. Clarence T. Johnston, of the University of Michigan, who at that time was assistant chief of the Irrigation Investigations of the United States Department of Agriculture, and at a still later date by Prof.

Joseph Le Conte, of the University of California. Professor Le Conte has further pointed out, in correspondence addressed to me, that by expanding in series the form to be integrated in deriving an expression for the discharge, it is seen that a weir notch may easily be devised to give a discharge proportional to any desired power of the head on the crest.

In addition to the uses indicated in my article, the weir has been employed to a limited extent to measure the flow in small farm laterals used for irrigation, the weir being set in a diaphragm which has a sharp edge on the bottom and sides, so that it may be set down at any place in such a lateral where the banks are high enough to prevent overflow from the water backing up above the weir. I believe some use has been made of it in the laboratories of the University of Illinois.

O. V. P. STOUT.

University of Nebraska, Lincoln, Neb.,
June 28, 1914.

[The weir form of Prof. Stout was exactly the same as that shown by Prof. Rettger, being of such outline that the breadth of the notch at any point is inversely proportional to the square root of the height above the crest. The formula is demonstrated, viz., discharge is directly proportional to depth of flow over crest. Prof. Rettger's method of correcting the weir form for varying coefficient of discharge is an addition to the subject, apparently.

Prof. Stout pointed out the disadvantages of this weir: its limited capacity, and the greater loss of head than in other forms of weir. At capacities over about 2 cu.ft. per sec., he says, the weir becomes ungainly.

The weir was used to measure water pumped by windmills at the farm of the Nebraska Agricultural Experiment Station. Prof. Stout believed it to be applicable to a variety of water measurements in agricultural, industrial and domestic use.

The value of the proportional-flow weir—or weir-notch—has not been recognized sufficiently, it would seem. That the Stout notch found use only locally and then was forgotten is surprising. However, similar notches are used in chemical-feeding devices in water purification.—EDITOR.]

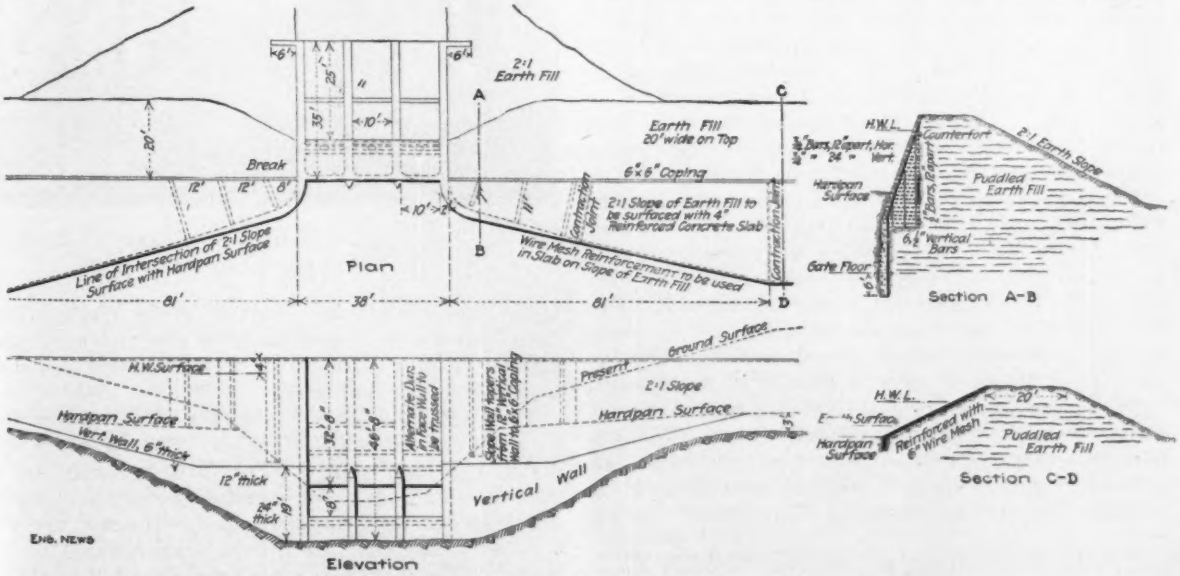
NOTES AND QUERIES

What Is a Bituminous Macadam Pavement?—George C. Warren, President of Warren Brothers Co., Boston, Mass., objects to calling some of the roads illustrated on pages 1342-1344 of our issue of June 18, bituminous macadam. He recognizes the illustrations as those of roads constructed by the "Warrenite" process, which he says is a bituminous concrete, quoting as authority the definitions recommended by the committee on bituminous paving nomenclature of the American Society of Municipal Improvements, and adopted by the society in 1911. That was three years ago, but to establish a change in language is extremely difficult, and we believe it is still common to call any road in which broken-stone aggregate is held together by a bituminous binder a bituminous macadam, irrespective of whether the road was constructed by the penetration process or by mixing, or whether it has or has not the "inherent stability" claimed for the "Warrenite" construction.

Design of the Davis Reservoir Outlet, Turlock Irrigation District

In connection with the account, last week, of the failure of the Davis Reservoir embankment in California, a field sketch was shown of the outlet—one side of which gave way. We are able this week to present in more complete form the design of this part of the works.

In Testing for Gas in Coal Mines, small animals may be used repeatedly without danger of their being less susceptible to carbon-monoxide poisoning after many exposures than after the first, if they are allowed to recover between exposures. An investigation of the Bureau of Mines, the results of which were published in Technical Paper 62, showed that canaries are less resistant to CO poisoning than mice, chickens, rabbits, guinea pigs, or dogs. The bulletin recommends that canaries be used wherever possible, and that at least three of them be carried by an exploration party. Men may display distress in the presence of proportions of carbon monoxide as small as 0.10%; whereas small animals, in the same atmosphere, may show no signs of being affected.



DESIGN OF DAVIS RESERVOIR OUTLET, TURLOCK IRRIGATION DISTRICT
(Reproduced from a drawing in the District office, dated 1912, prior to construction.)

The Largest Elevated Steel Tank

By R. W. Becker*

The surge tank just completed at Altmar, N. Y., for the hydro-electric power plant of the Salmon River Power Co., is the largest known structure of its kind, having a total capacity of 1,500,000 gal. This is a hemispherical-bottom tank with a cylindrical portion, 50 ft. in diameter and 80 ft. high. It is supported by ten steel columns raising the top of the tank 185 ft. above the top of the foundation. These columns are braced by two sets of struts forming the equal tower panels each about 34 ft. long.

This surge tank, located on the top of a hill, is connected to the lower end of a pipe line conveying water from the dam to the penstocks. The pipe line is 9500 ft. long, being 11 ft. in diameter at the dam and terminating in a 12-ft. distributer pipe. Four penstocks 8 ft. in diameter lead from the distributer pipe to the power plant below. The entire plant is designed to generate 40,000 hp.

A 12-ft. tee in the distributor pipe connects to the 12-ft. riser pipe of the surge tank. This riser terminates in an expansion joint below the tank so that about four feet of the pipe are carried directly by the tank bottom. To this latter piece of pipe the inner 10-ft. riser pipe is connected by twelve vertical I-beams. This is 100 ft. long and is carried entirely by the tank bottom. The only point of bracing is at the top where the riser flares out to a diameter of 15 ft. The lower end has a diameter of 10 ft. 8 in., thus affording an annular opening 8 in. wide between the two riser pipes.

This feature of the construction makes the surge tank a "differential regulator" and the twelve spaces into which the annular opening is divided by the I-beam connections are called "differential ports." The principal function of these ports is to retard the flow from the main tank to the turbines when the load on the plant is suddenly increased, so as not to apply the full accelerating head to the pipe suddenly; another function being to check the rise in pressure more gradually than would be the case without such ports, when load is thrown off. This is the invention of Raymond D. Johnson† of Niagara Falls, N. Y. On account of the economy of the "differential regulator," its extensive use in hydro-electric power installations is expected in the future.

The water, surging up and down, causes a difference in the water levels of the tank and the riser pipe which at times is very considerable. When the water rushes out, the difference in the water levels causes an external pressure on the inner riser pipe tending to collapse it. The ½-in. plate of this riser was reinforced by an angle 4x4x½ in. every 3 ft. 6 in., riveted on the inside so as safely to withstand an external head of 65 ft. of water.

The sudden exit of water also causes a partial vacuum which affects the tank and protective ceiling. This external pressure was assumed not to exceed 100 lb. per sq.ft. Swinging doors in the ceiling were designed to minimize the external pressure. The assumed loading necessitated the reinforcement of seven of the 8-ft. ta rings with a pair of 5x3½x$\frac{7}{16}$-in. angles on each. this is shown in Fig. 3.

The entire tank and riser are inclosed by double cypr sheathing attached to 3x12-in. pine studding so as form a 12-in. air space. The lower sheathing inclose stairway to the bottom of the tank from which level inclosed steel ladder leads to the top and inside of t

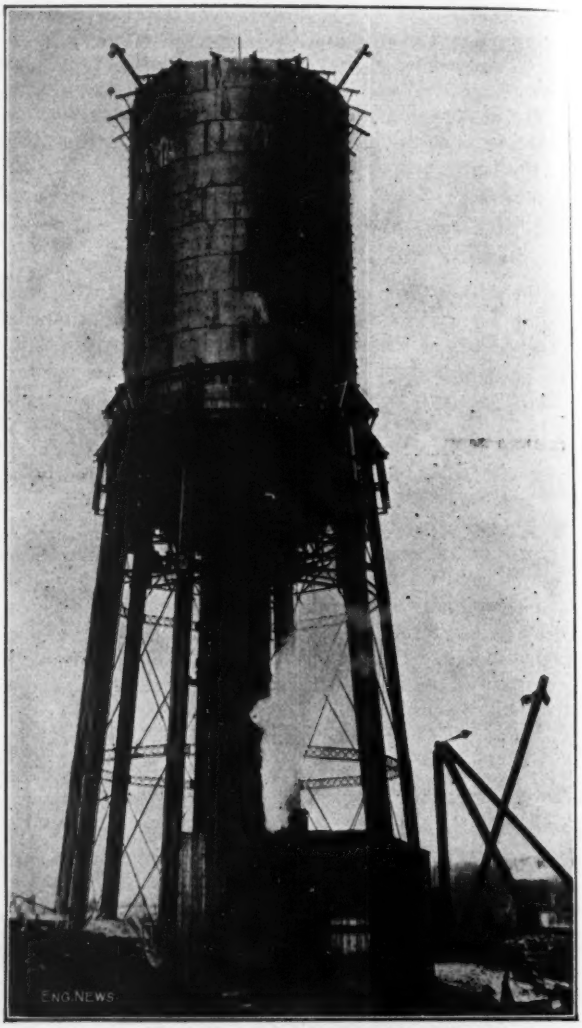


Fig. 1. The 1,500,000-Gal. Surge Tank at Altmar, N. Y., Nearing Completion

tank. Hot air will be circulated within the inclosure from heaters at the foot of the lower riser pipe when temperature conditions require it. The entire tank inclosure is carried by the steel work.

The wood ceiling is carried on the lower chords of the ten main and ten half-roof trusses. The trusses are also designed to carry a live-load of 40 lb. per sq.ft. and a suitable wind load. An asbestos covering on double sheathing and wood purlins is used. The roof projects 6 ft. over the tank, the trusses being stiffened by 20 brackets. These brackets extend down the full height of the top ring, thus reinforcing the latter under the heavy roof loads. The top of the tank is reinforced by a 6x6x

*318 46th St., Corona, L. I., N. Y. Formerly designing engineer and chief draftsman, Kennicott Co., Chicago Heights.

†The "differential regulator" is fully explained in a paper written by him for the American Society of Mechanical Engineers in June, 1908. It is entitled "The Surge Tank in Water Power Plants."

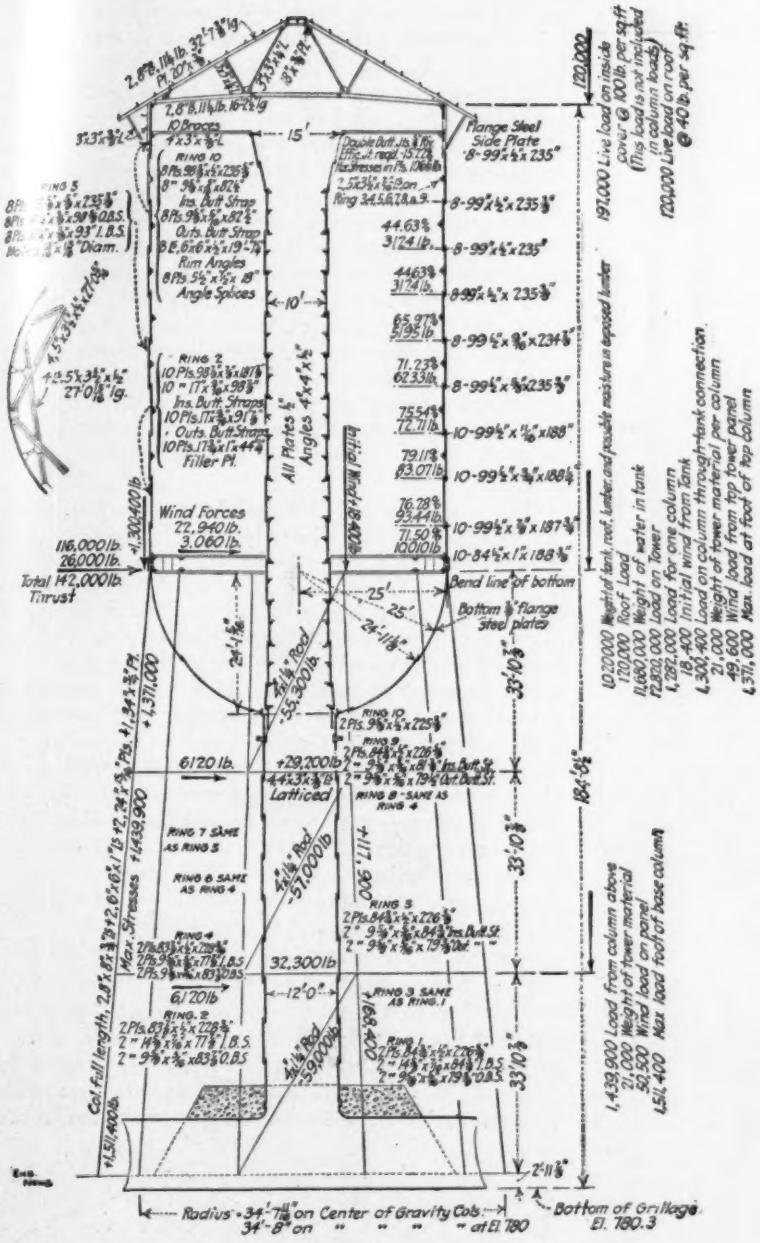

Flange Steel Side Plate
Bend line of bottom
Bottom ⅝" flange steel plates
Wind Forces
72,940 lb.
3,060 lb.
Total 142,000 lb. Thrust
Latticed
Radius 34'-7⅞" on Center of Gravity Cols.
34'-8" on " " " " at El. 780
Bottom of Grillage El. 780.3

FIG. 3. DIAGRAMMATIC ELEVATION OF ALTMAR SURGE TANK, WITH STRESSES, ETC.

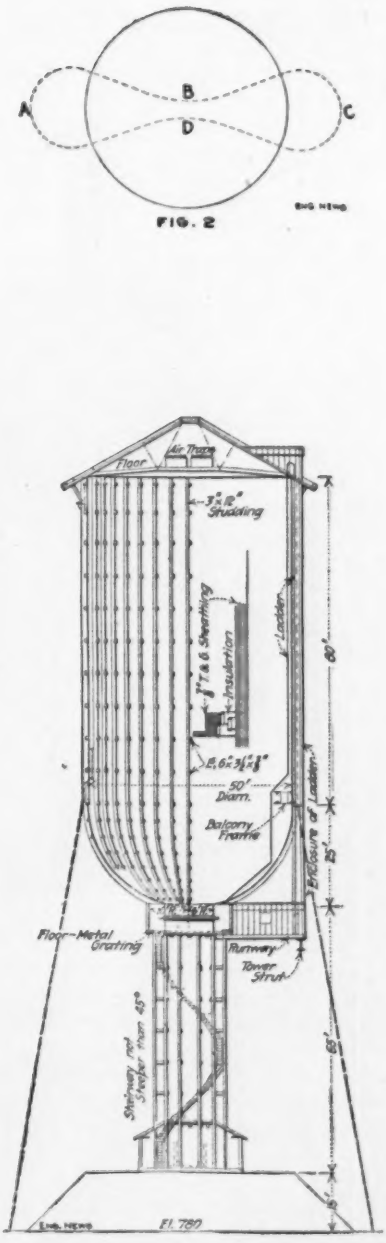


FIG. 4. PROTECTIVE COVERING FOR STEEL TANK AND UPTAKE

½-in. angle to take the horizontal thrust of the roof trusses, and to hold the tank in a circular form. The tank is also stiffened by the ten braces holding the inner riser pipe in alignment. No plates less than ½ in. thick were used in the tank and riser pipes. All plates were of openhearth flange steel and all steel was rigidly inspected at the mill. The specifications for the shop fabrication were in accordance with the best practice in bridge construction.

On account of the limited space of this article a discussion of all the original features of this design is not given, a few are mentioned briefly. The method of determining the stresses involved due to the external forces assumed on the main tank and riser pipes is entirely original. External hydrostatic or similar forces on a perfect cylindrical form can produce only a pure compressive stress in the shell just as the internal hydrostatic forces can produce only pure tension. The only difference between the two loadings is that while the internal one tends to correct any deviation of the cylinder from a perfect circular section, the external one tends to increase the deformation and consequently tends to increase the stresses.

From observation, we notice that when a pipe fails by collapsing due to an internal negative pressure, two diametrically opposite sides try to meet while the other

FIG. 5. ALTMAR TANK IN SECOND STAGE OF ERECTION

two sides increase the distance between them as far as possible. The usual tendency is for not more than two sides of a pipe to cave inward. There are, therefore, four points of metal, *A*, *B*, *C*, *D* (Fig. 2), which when considered very small, show no relative movement with the adjacent metal. All molecules of metal between these points, however changed their positions with reference to adjacent molecules in their movement from the cylindrical portion of the tank sufficient to show no inal circular section. It, therefore, follows that the lapse is due entirely to the inability of the metal betw the points noted, safely to carry the imposed stresses. before stated, the stresses are purely compressive. T metal between *A* and *B* must, therefore, have failed a column whose length is the distance from *A* to *B* m ured on the center line of the plate. The distances tween the four points are approximately equal, their equality being due only to variations in the rigidity the plate. Therefore, to design a cylindrical shell for e ternal hydrostatic pressure, we need only consider on fourth of the circumference of the plate as the colum length. The stress in this column is computed the sam as for the internal pressure, and is equal to the hea times the radius in inches. When the slenderness rati is large, Euler's formula for long columns should be used.

If the section of plate required for the computed stress is very thick, it is preferable to use a lighter plate with some reinforcement at regular intervals. The column then consists of a width of plate equal to the distance between reinforcements, with the reinforcing section at the center of the plate. The reinforcement used on the tank and standpipe can be checked by this method.

The principal stresses in the tank bottom are due to (1) the head of the water in the tank; (2) the weight of the 10-ft. riser pipe; and (3) the 12-ft. opening for the riser connection. The thickness of plate used is sufficient to take all these stresses without following the custom of concentrating metal around the opening. The local concentration of metal in any stressed spherical shell is an objectionable feature. The stresses due to the opening are a maximum at the bottom and gradually diminish until they vanish at the top of the bowl.

Only one thickness of plate is used which would indicate an unnecessary thickness of plate at the top if the method of support is not considered. As the tank is supported at ten individual points, a concentration of stress results at these points, which fact is ignored by most designers. The magnitude of the increased stresses at the supports varies in different designs with the actual

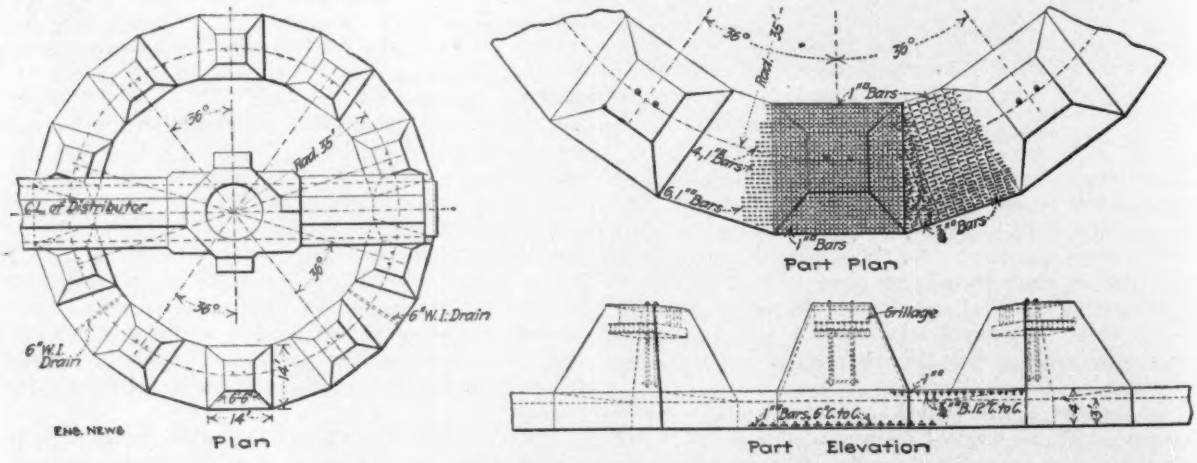


FIG. 6. FOUNDATIONS FOR ALTMAR SURGE TANK

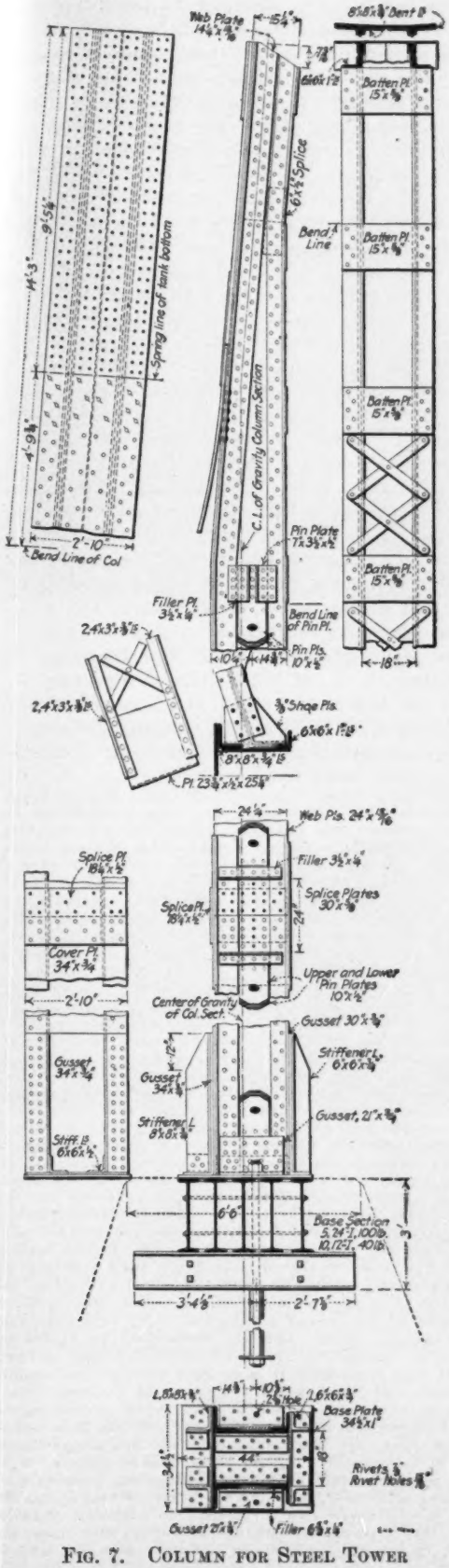


FIG. 7. COLUMN FOR STEEL TOWER

elongation of the material in the span between posts. To obtain a uniform stress in the bowl between supports, it would be necessary to use a thickness of steel in the ceptible elongation under full loads.

There must also be a circular reinforcement in a horizontal plane at the top of the bowl sufficient to permit of no inward deflection between these supports. As such requirements are not practical, it is advisable to ascertain the additional stresses caused due to the elongation of the tank plates used. The bottom plates should be thick enough to take these additional stresses and come within the allowable unit stresses, and the riveting on the horizontal seam should correspond. On the usual sizes of

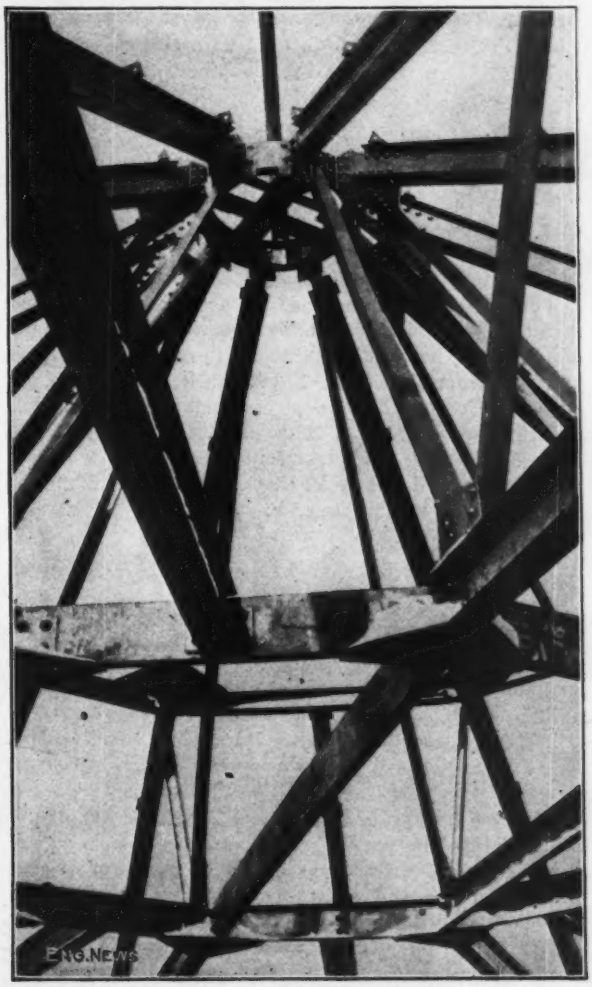


FIG. 8. ROOF FRAMEWORK FROM INTERIOR

tanks, these stresses are important only when large spans are used between supports. The bottom as here designed reduces bending stresses in the lower part of the tank cylinder to a minimum. Most designers are content to have the factor of safety take care of these stresses in the lower rings. Tank bottoms which are comparatively flat spherical segments or shallow elliptical bottoms depend almost entirely on the cylindrical shell to carry the transmitted shears to the posts.

The horizontal thrust of the columns at the top is carried by an interior truss work which also stiffens the

bowl between posts. Further stiffening is accomplished by the two horizontal butt straps. On account of the importance of this structure a factor of safety of not less than five was used throughout.

Each of the ten columns is anchored by means of two 2½-in. bolts. They rest on a double tier of steel-grillage beams which are set at an angle to take the load of the columns normally. The beams rest on concrete piers which are connected at the bottom by a heavily reinforced-concrete slab connecting them in a circle.

The tower, first ring, bowl and part of riser pipe were erected by means of a special steel derrick consisting of a 140-ft. mast, a 125-ft. boom and having a 20-ft. bull-wheel. The upper 10 ft. of riser pipe was then completed and two 40-ft. swinging booms attached near its top from which the tank and roof trusses were erected (Fig. 5). All rivets were driven by pneumatic hammers and the work was closely inspected in the field as well as in the shop. The few leaks which were found after testing were quickly stopped. The tank was tested during very cold weather in order to rush its completion. To keep ice from forming on the water, a 2-in. steam pipe was run over the top of the tank and by the use of three swivel joints, was supported on floats which held the steam nozzle a few inches below the water surface.

This structure was designed by the writer for the Kennicott Co., of Chicago Heights, Ill., who fabricated and erected it. The work was directly in charge of the general superintendent, Chas. F. O'Connell. The Erie Construction Co. are the general contractors for the hydro-electric power plant. R. D. Johnson, their hydraulic engineer, made the complete specifications. The work was passed upon in detail by V. G. Converse, Chief Engineer of the Salmon River Power Co.

A Real Fireproof Building

The June 25 fire at Salem, Mass., produced one very striking example of the fire-resisting qualities of a well built concrete building with the openings thoroughly protected by wire-glass and by fusible-link shutters. The large plant of the Naumkeag Steam Cotton Co. was located at the extreme eastern end of the burned area and was almost the last place the fire reached. Like everything else in the path of the fire, all of the buildings were destroyed, with the exception of a reinforced-concrete storehouse and an old gasometer, which had also been used as a cotton storehouse.

The reinforced-concrete warehouse, built about eight or nine years ago, is 60x100 ft. in plan and four stories high. It is of reinforced concrete throughout, with straight column-and-girder construction, having plain slabs reinforced with expanded metal spanning the girders and with curtain walls between the columns. The roof was covered with tar and gravel. The outside walls are provided with small windows, glazed with wire-glass set in iron frames and protected on the inside by hinged, metal-covered shutters, ordinarily held open by chains with fusible links at the outer ends. The building was designed and built by the Eastern Expanded Metal Co.

The warehouse is bounded on two sides by streets, while a third side faces a wide alley, so that only one side, where buildings stood within 6 ft., was subjected to the fiercest flames. The difference in the intensity of the heat to which opposite sides of the storehouse was exposed, is shown by the fact that, while on one side the rain-water conductors and the zinc flashing at the edge of the roof were melted down, on the opposite side, which faces a 40-ft. street, a wooden beam, bolted to the wall of the building to carry insulators for electric wires, was not even charred. The buildings on the opposite side of the street were, however, burned, and the heat on that side, as well as on the others, was sufficient to melt the fusible links holding the window shutters so that all of them were closed automatically.

That the temperature inside the building did not become excessively high is shown by the fact that the fusible heads of the sprinkler system, set to melt at 166° F., did not open in a single instance. Neither was the white paint, with which the interior walls are covered, blistered, and practically no damage was done to the $30,000 worth of finished goods which the storehouse contained.

The outside walls of the building appear to be absolutely unhurt. Most of the wire-glass in the windows is badly cracked, but no other damage is apparent and one would not guess that the structure had been in the midst of a conflagration except for the surroundings. The building cost about $25,000 to build, including the elevator and electric work. This is about 12c. a cu.ft. of volume above the street level.

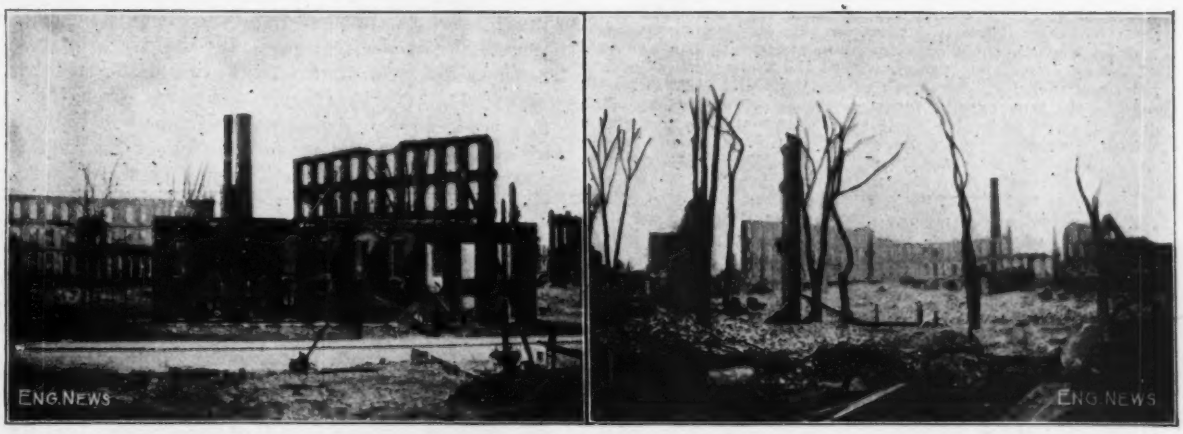
The Manufacturers' Mutual Fire Insurance Co., of Providence, R. I., of which John R. Freeman, M. Am. Soc. C. E., is president, which had to pay about $800,000 for the losses in the Naumkeag company, has issued statement of the conditions around that plant. From that report we give below some extracts.

The loss is by far the greatest single loss that has ever occurred in the seventy-nine years' experience of the Factory Mutual System. The loss next in importance to this was that of the Warren Manufacturing Co. about nineteen years ago, in which the mutuals lost less than one-fourth part of the present amount. The present loss involves one of the largest payments (if not the largest) ever made to a single corporation for a fire loss. It is of interest to note that although more than 250 acres closely covered with dwellings, etc., was burned over, about one-fourth of the whole value burned was in this one factory yard.

The loss was in every way a legitimate one, and the exposure could not have been fairly called bad enough to forbid taking the risk. The risk bordered Salem Harbor and was divided into six principal buildings, separated by reasonably broad open spaces. The flames and smoke were driven toward these from a burning area extending over a mile back and a third of a mile in width and struck these mills along their exposed front of about a quarter of a mile in length with a heat that no ordinary construction could withstand. Moreover, this was almost at the end of the conflagration, the city water pressure had been rendered practically useless by fire drafts and broken pipes, and no public fire apparatus and no public firemen put in an appearance at the mill or rendered the slightest assistance. A few men of the factory organization worked valiantly and worked to the limit the mill's two big fire pumps fed from the harbor, and when these men were finally driven away they left the pumps running at full speed and a full head of steam on the boilers. They had to escape (with two of the factory mutual engineers who were on the ground helping the fight) by a boat, the mill being then all on fire, entirely surrounded by flames on the land side. Along the front, after the fire had reached the mill, it was impossible to man hose lines in the smoke and heat and more sprinklers were opened by heat than the pumps could supply. A radical substitution of new machinery for old throughout most departments had just been completed and last year they had remodeled their fire protection appliances at an expense of about ten thousand dollars.

No more complete burning of everything combustible has ever been witnessed, with the exception of two storehouses—one a low circular structure, without windows (formerly a gasometer) used for the storage of cotton; the other, a new, four-story concrete storehouse for finished goods, which had

FIG. 1. A REINFORCED-CONCRETE SURVIVOR OF THE SALEM FIRE. STOREHOUSE OF THE NAUMKEAG STEAM COTTON CO.



FIGS. 2-3. CONDITION OF THE REMAINDER OF THE NAUMKEAG PLANT AFTER THE FIRE

small wire-glass windows in iron frames, reinforced on the inside by tin-clad shutters dropped by automatic fusible links. This building, although surrounded on all sides by a sea of flames, came through the fire practically uninjured, except for the cracking and melting of the wire-glass in a few of the windows and a little smoke damage.

This concrete storehouse is a most instructive object lesson as to the feasibility of building storehouses at moderate cost that will withstand the fiercest conflagrations, and is well worth a visit by anyone about to build a storehouse.

The Cost of City Government in 195 American cities having 30,000 population and over is reviewed by the Census Bureau in a bulletin shortly to be issued. The statistics give the total cost of carrying on the general government, police and fire departments and all other protections to person and property, conservation of health, sanitation and street cleaning, care of highways, charities, hospitals and correction and conduct of education and recreation. Expenses in connection with public service enterprises, such as municipal waterworks, etc., are not included. The average annual per capita payment for the 125 cities is $17.34. The expense is higher, however, in the larger cities. In the cities of group 1, having a population in excess of 500,000, the average per capita cost is $21.24. In this group Boston has the largest ratio of expense, the amount being $28.06, and Baltimore has the lowest, the amount there being $15.14. In the group of cities having 300,000 to 500,000 population the average per capita expense is $20. In this group Washington is the most expensive city, the per capita cost being $25.43, and New Orleans the lowest, with $12.79. In the cities with 100,000 to 300,000 population the average per capita cost drops to $14.22, in the cities with a population of 50,000 to 100,000 the cost is $12.06 per capita, and in the cities of 30,000 to 50,000 population the cost is $11.69 per capita. As would be expected, however, there is great variation in the cost of city government in the different cities. In Mt. Vernon, N. Y., for example, the per capita cost is $27.53, and in Charlotte, N. C., it is only $6.44. The statistics also show a large and steady increase in the payment per capita on account of police, fire and education. The per capita expenses for education increased from $3.61 in 1902 to $5.02 in 1912.

The Newly Created State Department of Health of Massachusetts

The Massachusetts State Board of Health was legislated out of office on July 7. In its place, there was created a State Department of Health consisting of a single commissioner as executive officer and a council of health. The council will be made up of the commissioner and six other members. It will make rules and regulations, and perform other functions, not clearly defined, but will have no administrative or executive functions. The act substantially in full is as follows:

AN ACT

To create a State Department of Health and to amend the Public Health Laws.

There is hereby created a state department of health which shall exercise all the powers and perform the duties now conferred and imposed by law upon the state board of health. The state department of health shall consist of a commissioner of health and a public health council. There shall also be directors of divisions, district health officers and other employees as hereinafter provided.

The commissioner of health shall be appointed by the governor, with the advice and consent of the council, and he shall be a physician skilled in sanitary science and experienced in public health administration. The term of office of the commissioner of health shall be five years. He shall receive an annual salary of $7500, and shall devote his entire time to his official duties. The commissioner of health shall be the administrative head of the state department of health. His powers and duties shall be to administer the laws relative to health and sanitation and the regulations of the department; to prepare rules and regulations for the consideration of the public health council; to appoint and remove, with the approval of the public health council, directors of divisions, district health officers, inspectors and other necessary employees and fix their compensation, subject to the approval of the governor and council, within the limitations of appropriations therefor. Directors of divisions and district health officers shall be exempt from civil service regulations. The commissioner of health shall submit annually to the public health council a report containing recommendations in regard to health legislation, and shall perform all executive duties now required by law of the state board of health and other duties incident to his position as chief executive officer. He may direct any executive officer or employee of the state department of health to assist in the study, suppression or prevention of disease in any part of the commonwealth.

The public health council shall consist of the commissioner of health and six members, hereinafter called the appointive members, at least three of whom shall be physicians, all to be appointed by the governor, with the advice and consent of the council. . . . The terms of office of the said members . . . shall be three years. Vacancies shall be filled by appointment of the governor, with the advice and consent of the council, for the unexpired term. The public health council shall meet at least once in each month, and at such other times as they shall determine by their rules, or upon the request of any four members, or upon request of the commissioner of health. The appointive members shall receive $10 a day while in conference and their necessary traveling expenses while in the performance of their official duties. It shall be the duty of the public health council to make and promulgate rules and regulations; to take evidence in appeals; to consider plans and appointments required by law; to hold hearings; to submit annually to the general court, through the governor, a report, including recommendations as to needed health legislation; and to discharge other duties required by law; but it shall have no administrative or executive functions.

There shall be in the state department of health such divisions as the commissioner of health may, with the approval of the public health council, from time to time determine. The commissioner of health shall appoint and may remove, with the approval of the public health council, a director to take charge of each division, and shall prescribe the duties of such division. The compensation of directors of divisions shall be fixed by the commissioner of health, within the limits of appropriations therefor, and subject to the approval of the governor and council.

The commissioner of health, with the approval of the public health council, shall, from time to time, divide the state into eight health districts and shall appoint and may remove a district health officer for each district, with the approval of the public health council, at a compensation subject to the approval of the governor and council, not exceeding $3500 a year. The district health officers shall not engage in any other occupation and shall give their entire time to the performance of their duties. The commissioner of health may, from time to time, order two or more of said district health officers to work in one district in order to abate, suppress or prevent disease. Each district health officer shall have all the powers and perform the duties now provided by law for inspectors of health and further shall, under the direction of the commissioner of health, perform such duties as may be prescribed by, and shall act as the representative of the commissioner of health and under his directors shall secure the enforcement within his district of the public health laws and regulations. Said district health officers shall be graduates of an incorporated medical school admitted to practice in the Commonwealth, or shall have had at least five years' experience in public health duties and sanitary science.

. . . Present employees shall be continued in office until their successors are appointed and qualified, or until removed by the commissioner; provided, however, that no employee shall be removed who was appointed or is now employed under the provisions of the civil service laws and regulations, other than for cause, except division heads and district health officers, who shall be appointed as hereinbefore provided.

As the original bill was promoted by the Governor, it is assumed that he will sign it. The bill will then go into effect on Aug. 6, 1914.

Denver Municipal Bonds for Moffat Tunnel Declared Unconstitutional

The Colorado Supreme Court has denied the right of the City of Denver to issue bonds for driving a tunnel through the Continental Divide to be used by the Denver & Salt Lake R.R. and for the transportation of water and electric current (as described in ENGINEERING NEWS, Jan. 29, 1914). The city was given the right to proceed with this work and a commission was created by a constitutional amendment adopted May 20, 1913. After the issuance of the Tunnel Commission's report, the bonds were approved by the voters of the city on Feb. 17, 1914 (as noted in ENGINEERING NEWS, Mar. 5, 1914, page 541).

The court declared the tunnel contract unconstitutional and characterized it as a deliberate attempt to evade the constitution, coming within the fundamental inhibition against the use of municipal funds for the credit or benefit of private corporations. The counsel for the Tunnel Commission argued that there were four reservations taking the matter out of constitution limitations. The court overruled each of these, holding (1) that the city had made no provision to pay for the construction of conduits through the tunnel, that it had secured no right to use water from the western slope, and that it had not declared its intention of acquiring such right; (2) that the same facts hold as to the use of the tunnel for the conveyance of electricity; (3) that, in regard to the city's reservation of right to mineral discovered in driving the tunnel, the city has no right to levy tax for the purpose of locating mineral claims; (4) that, in regard to the use of the tunnel by more than one railroad, no showing was made that any other road desired to use the tunnel.

The court concludes that these provisions in the contract were inserted in an effort to evade constitutional prohibition.

Notice has been given by the Tunnel Commission and City Attorney that an attempt will be made to recall the

decision under an amendment adopted in 1913, which permits a judical decision involving constitutional questions to be reviewed and recalled by a vote of the section of the state interested. In spite of this, it is reported that there seems no certainty of such an effort being supported by the Denver vote, and it is possible that the Supreme Court would step in again and deny the right of one part of the state to change a constitutional provision applying to the whole state.

Therefore, at the present moment, early completion of the project seems to hinge on the willingness of the railroad company to complete the construction of the tunnel without the city's coöperation.

The Strength of Lime Mortar*

The scanty data on strength of lime mortar are much amplified by test results of W. E. Emley and S. E. Young, presented in a paper under the above title. By mixing in the mortar a 1% solution of "Wool Blue R," the setting of the mortar can be observed in broken specimens; the dye colors the calcium carbonate blue, but leaves the hydrate colorless. In the broken specimens, a blue exterior shell was seen, showing the penetration of the atmospheric carbon dioxide, which converted the lime hydrate into hard carbonate.

A set of compressive and tensile tests made on various commercial limes in 1:3 mortar at 6 mo. age, in 2-in. cubes and standard briquettes, gave results tabulated below. The important feature is the higher strength of the dolomitic limes, shown near the bottom (low CaO content). The high-calcium mortars crush at 100 lb. per sq.in., while the dolomitic limes crush at 300 lb. per sq.in.

The high-calcium limes acquired strength somewhat earlier than the dolomitic limes, but at 1 mo. age the latter were 50% stronger in compression and continued to gain strength faster than the high-calcium limes.

Since lime mortar hardens from the surface inward, large cubes show lower strength than small cubes. At 3 mo., 6-in. cubes were only ⅓ to ¼ as strong as 1-in. or 2-in. cubes. Prisms of equal cross-section, with different ratios of exposed surface to volume, showed much greater strength.

The strength of mortar increases with the fineness of the sand. Both high-calcium and dolomitic limes showed 2½ times as great a crushing strength with sand of 60 to 80 mesh fineness as with sand of 10 to 20 mesh. Excessive water weakens the mortar, but below a certain minimum of water, varying from 15% to 35% for the various lime-sand mixtures tried, there is a very great drop in strength.

Adding lime to portland-cement mortars, both neat and 1:3, did not weaken the mortar appreciably at ages up to 1 yr., provided the amount of lime did not exceed one-third the amount of cement. This applies to both compressive and tensile strength, and either air or water storage.

TABLE I. COMPRESSIVE AND TENSILE STRENGTHS OF LIME MORTARS

(Mixture 1 part lime to 3 parts river sand. Age 6 months).

Quicklime			Hydrated Lime		
CaO, per cent.	Compressive strength, lb. per sq.in. (av. of 10)	Tensile strength, lb. per sq.in. (av. of 5)	$Ca(OH)_2$, per cent.	Compressive strength, lb. per sq.in. (av. of 10)	Tensile strength, lb. per sq.in. (av. of 5)
98.41	72	28	92.98	61	21
98.13	90	43	91.77	80	31
98.13	48	28	88.78	153	46
97.78	104	30	88.42	128	48
97.65	98	40	87.78	95	19
96.22	118	29	82.46	188	47
95.81	156	36	74.38	130	28
95.38	73	21	61.44	148	22
95.01	129	33	57.27	222	29
94.64	156	45	54.05	165	37
94.09	85	25	52.19	259	67
93.84	147	63			
92.56	154	31			
92.45	156	36			
92.23	92	36			
89.29	144	40			
86.23	126	40			
84.51	119	43			
84.41	113				
60.87	186	44			
60.40	280	63			
58.10	313	50			
56.95	391	84			
56.93	319	41			
56.33	315	59			
55.98	303	93			
55.06	303	71			

*Abstract of paper presented before the American Society for Testing Materials, Atlantic City, June 29-July 3.

NEWS NOTES

A Wood Highway Bridge Collapsed under the load of a moving automobile near Dale, Mich., on June 30. The automobile came down a steep hill and onto the structure, through which it fell to a shallow stream 30 ft. below.

The Steamship "Invermore" Went Ashore near Brig Harbor, on the Labrador coast, on July 10. The "Invermore" is owned by the Reid Newfoundland Ry. Co. and carries passengers, mail and freight. She is a single-screw steamship, 250 ft. long, 30-ft. beam, built in 1881, and is commanded by Captain J. Kanel.

A Large Flywheel Burst in a cooperage factory of New York City, on July 6. Five minutes after the shop machinery was started the flywheel, 5 ft. 6 in. in diameter, burst. Many of the smaller machines were wrecked; but due to the early hour few men were at their places and only two were injured. A 300-lb. piece of the wheel was hurled through a window and through the wall of an adjacent tenement house.

A Sandy Hook Pilot Boat Was Sunk at the entrance of the Ambrose Channel, New York, recently by the United Fruit steamship "Manchioneal," outward bound in a fog. The crew of the pilot boat (the "New Jersey") was taken off by vessels in the vicinity. The "Manchioneal," of 1600 tons, continued on her voyage to Jamaica. The "New Jersey" was a 248-ton wooden vessel, 144 ft. long.

The First State-Aid Roads to be built under the new Illinois law in Logan County are to be of concrete, 10 ft. wide, with 8-ft. strips of waterbound macadam on the sides.

Work Begun on Hetch Hetchy Road—City Engineer M. M. O'Shaughnessy of San Francisco recently visited the Hetch Hetchy Valley personally to supervise the beginning of the first construction road to the dam site. Work was started on a road 8⅓ miles in length. It will first be used as a wagon road, but later railroad tracks will be laid upon it.

City Waste Collection and Disposal in Chicago is to be investigated by a special engineering commission, with a view to working out a system to be adopted by the city. The council has made an appropriation of $35,000 for the work and the necessary experimental plant and equipment. This is the result of the report of a former commission, which report has been given in abstract in our columns.

The Longest Tunnel in America—The Mount Shasta Power Corporation is pushing construction on a seven-mile tunnel to carry water from the Pitt River, in Shasta County, Calif., to the forebay of its projected power house. The tunnel so constructed is to be 7 ft. wide and 9 ft. high. Later it will be enlarged to a width of 16 ft. and a height of 19 ft. Crews are working at both ends, the aggregate length of the two sections now being a little over a mile. The entire length will be completed as a 7x9-ft. section before the bore is enlarged.

Systematic Sale of Inferior Cement Discovered in San Francisco—The Commissioners of the Board of Public Works of San Francisco have discovered that deteriorated cement is being disposed of in large quantities throughout that city. The yards of a prominent firm of contractors were inspected and sacks of the spoiled product found in abundance. The Commissioners have received reports that certain building foundations are crumbling away, which leads to the belief that a ring of dishonest dealers are systematically marketing a very inferior mixture.

The City of Long Beach, Calif., is held responsible for the condition of its municipal pier, which collapsed on May 24, 1913 (See Eng. News, June 19, 1913, p. 1288), killing 41 persons and injuring some 200 more. In a test case brought before the Supreme Court of the state, damages to the extent of $7500 were awarded to a man for the death of his wife in the accident. If the precedent holds, the city will be mulcted of several million dollars. It will be remembered that the pier in question was a timber structure of strikingly weak design and in a poor state of maintenance.

Federal Aid to Good Road Construction was provided for to the amount of $25,000,000 in the Shackelford bill passed by the House of Representatives some months ago. The bill has since been in the hands of the Senate Committee on Post Offices and Post Roads, of which Senator Bankhead, of Alabama, is chairman. A letter of Senator Bankhead's dated July 2, says:

> The committee is diligently at work perfecting the bill and I have no doubt that in a few days a report will be made. The bill will probably be along the line of the discussions at the meeting of the United States Good Roads Association at St. Louis last November.

A District Water Supply Project for Cohoes, Waterford, Watervliet, Green Isand, N. Y., and adjacent territory has been launched by the State Conservation Commission. This is the so called Charlton project to use the waters of Aplaus Kill, Saratoga County, some 25 miles northwest of Albany. A dam would be constructed to create a 3000-million-gal. storage reservoir. The population of the proposed union district is 51,000, with a present consumption of 6,300,000 gal. per day; provision is planned for 15,000,000 gal.

This scheme conflicts with the plans of the city of Watervliet to take a supply from the Normanskill at French's Mills, using waterpower to pump through the supply line. Watervliet has secured enabling legislation, but has yet to secure the approval of the Conservation Commission.

The Height of Buildings in Chicago is limited by ordinance to 200 ft. A special permit was asked recently for a hotel building 260 ft. high, on Michigan Ave. When this was refused, an ordinance was introduced to permit the construction of 260-ft. buildings along Michigan Ave. where it fronts upon Grant Park and the lake. Fortunately this was rejected by the council, and it was shown very clearly that one cause of the great and increasing traffic congestion of Chicago is due to the tendency to confine the business district to a limited area by the construction of "skyscraper" buildings. The pressure for space is so great that office and mercantile buildings are now being built outside of the old central district, and the Chicago, Burlington & Quincy R.R. has even put its new office building on the west side of the Chicago River.

The Right of the Illinois Highway Commission to Make Contracts for Material for road construction has been upheld by the state courts in a decision handed down the last week in June. To prevent skimping of cement and other material the Highway Commission has decided to purchase the materials and furnish them to contractors who are awarded construction contracts. According to press dispatches from Springfield, Ill., July 1, the suit involved was filed at Sycamore, Dekalb County, where attorneys representing certain taxpayers sought to enjoin the State Highway Commission from purchasing cement and other materials. The attorneys, who originally were employed by a cement company which failed to get a contract from the commission, contended that inasmuch as the new road law did not authorize the commission expressly to purchase materials that body cannot legally make such purchases.

The Glasgow Dock Fire—It now appears that the piers and buildings around Kingston dock in Glasgow, Scotland, which were destroyed by fire on June 19, as noted in this journal, June 25, 1914, p. 1450, were being reconstructed and that the fire started in the creosoted timber piling to which was framed the timber flooring and the steel and brick sheds. A local report of the fire states that it originated in the creosoted piling and was caused by a workman using a hot iron to clean out a newly bored hole. There had been hot weather for several days, and that morning the temperature was higher than the normal, so that the piles were warm, and the creosote was in a very inflammable condition. When the workman inserted the hot iron in the hole in the timber the creosoting at once caught fire, and the flames ran from pile to pile on the surface of the wood with extraordinary rapidity. Their spread to the old piling around to the other side of the dock was only a matter of time, and the destruction of the piling meant the collapse of the front of the quays all around, and the falling into the dock of all the sheds and cranes.

Interference with the U. S. Geological Survey is the purpose of a bill (H. R. 13457) now in Congress, the first part of the title of which reads that it is "to provide a more equitable means of distribution of topographic and hydrographic surveys and other work of the U. S. Geological Survey." Its provisions include the following: (1) the appointment of the annual appropriation for topographic surveys and water resources investigations among the several States on the basis of area and population; (2) the distribution of the work within each State upon the recommendation of a majority of the congressional delegation; (3) the determination of the technical details of the topographic and hydrographic surveys by the Secretary of the Interior upon the advice and recommendation of the majority of the Congressional delegation from each State.

The scale for maps would be decided by each State, so that there would be no uniformity, and the general control of the work would be political (and of the pork-barrel variety) instead of scientific. The Western Society of Engineers and the Illinois Society of Engineers and Surveyors have sent protests to Congress against the passage of this bill. They refer to the high quality of the work of the U. S. Geological Survey, and the resolution of protest adopted by the first-named Society states that this bill is fundamentally wrong in that it substitutes the judgment of a majority of the Congressional delegation for that of the Director of the Geological Survey on matters which are purely technical.

An $85,000 Error in a $322,000 Bid for a bridge contract came very near proving disastrous to a firm of contractors, which was awarded a contract for he construction of the Central bridge at Lawrence, Mass. Shortly after the bids were tabulated, the contractor informed the bridge commissioners that he had made a mistake in his calculations aggregating about $85,000, the accepted bid being about $322,000. The next lowest bid was something like $101,000 higher than the one for which the contract was awarded. Subsequently, questions were raised as to the appropriation of the money for the construction of the bridge and the commissioners were given to understand that owing to certain legal questions the contractor would not undertake the contract. Legal proceedings were begun by him to prevent the bridge commissioners from enforcing the contract. Subsequently, however, an arrangement was made between the commissioners and the contractor whereby the foundation and excavation work to spring lines, including what is called in the contract "Class C concrete," should be done as force account work, namely, the total cost including labor and materials and use of plant as agreed upon by the consulting engineer and the contractor, plus 10%. B. H. Davis, Consulting Engineer, advised the commissioners to make the above change in the contract. It is estimated that the additional expense to the city will not exceed $10,000 over the bid submitted by the contractor. On the above basis a contract has been signed; a bond has been furnished, and the construction of the bridge begun. [Information from John J. Donavan, Chairman of Lawrence Bridge Commission.]

The Ohio Conservancy Act is still awaiting a final interpretation by the courts of the state. The present status of the act is reported by the Dayton Citizens' Relief Commission to be as follows:

> On June 3 the Court of Appeals rendered a decision upholding the constitutionality of the Conservancy Act of Ohio in all major points. The laws of Ohio provide that an appeal may be taken on error from a decision of the Court of Appeals within 70 days after the decision is rendered. In making its decision the Court of Appeals granted to the contestants a stay in its mandate to the Court of Common Pleas, or Conservancy Court, ordering the petition for the formation of the Miami conservancy district to be heard at once. This stay was granted until June 30 in order that the contestants might have time to decide whether they would take the case to the Supreme Court of the state on error before the Conservancy Court made any preparation to begin its hearing upon the original petition.
>
> The mandate of the Court of Appeals ordering the case back to the Conservancy Court was filed July 1. On July 2 attorneys for the contestants announced, after consultation, that they would take an appeal to the Supreme Court on error. They further announced that they desired to print the records in the case which would require, they said, about three weeks. As the 70-day period from the date of the Appellate Court's decision gives them until August 12, it is not likely that formal action in the appeal will be taken until the latter date. It is believed that once the case is brought before the state Supreme Court there will be little delay in a hearing, as the Ohio Conservancy Act was passed as an emergency measure and specifically provides that it shall be given precedence.

The "Storstad" Was Blamed for the loss of the "Empress of Ireland," by the Commission of Inquiry headed by Lord Mersey, in its report handed down at Quebec, Can., on July 11. The "Empress of Ireland," of the Canadian Pacific Ry., was rammed by the collier "Storstad" in the St. Lawrence River

on May 29 and sank near Father's Point with a loss of 1014 lives. Third Officer Tuftenes of the collier is held directly responsible, in the following words:

We regret to have to impute blame to any one in connection with this lamentable disaster, and we should not do so if we felt that any reasonable alternative was left to us. We can, however, come to no other conclusion than that Mr. Tuftenes was wrong and negligent in altering his course in the fog, as he undoubtedly did, and that he was wrong and negligent in keeping the navigation of the vessel in his own hands and in failing to call the captain when he saw the fog coming on.

The second important finding was that the disaster was not due in any way to any special characteristics of the St. Lawrence River. "It was a disaster which might have occurred in the Thames, in the Clyde, in the Mersey, or elsewhere, in similar circumstances."

The following is quoted from the report:

After carefully weighing the evidence we have come to the conclusion that Mr. Tuftenes was mistaken if he supposed that there was any intention on the part of the "Empress of Ireland" to pass port to port, or that she, by her lights, manifested the intention of doing so; but it appears to us to be a mistake which would have been of no consequence if both ships had subsequently kept their courses.

Shortly after the ships came into the position of green to green, as claimed by Capt. Kendall, or red to red, as claimed by Mr. Tuftenes, the fog shut them out from each other, and it is while they were both enveloped in this fog that the course of one or the other was changed, and the collision brought about. From the evidence adduced on behalf of both vessels it is plain that before the fog, and when they last saw each other, there was no risk of collision, if each kept her course.

It is admitted that those on board the "Storstad" did that which in ordinary circumstances would change her course, and they did it in the fog shortly before the accident. They ported and they hard-a-ported the "Storstad's" helm. Assuming that she answered to this hard-a-ported helm, the effect would be to bring her head around to starboard in the direction of the "Empress of Ireland," and if she continued in the direction of the "Empress of Ireland" under this helm the effect would be to bring her into collision with the "Empress of Ireland."

It may be asked what induced the men in charge of the "Storstad" (Mr. Tuftenes and Mr. Saxe) to port and to hard-a-port the helm. The explanation is fairly plain. They believed, wrongly as it turned out, that the "Empress of Ireland" was passing their ship red to red. They wanted, as Mr. Tuftenes said to Mr. Haight when he gave his first version of the story, "to make sure of ample room," and they ported in order to secure it. Unfortunately the "Empress of Ireland" was passing green to green, and so far from the porting securing more ample room, it brought the vessels into closer proximity, and then into collision.

The Commission of Inquiry is composed of Lord Mersey, formerly presiding justice of the British Admiralty Court; Sir Adolphe Routhier, of Quebec; and Chief Justice McLeod, of New Brunswick.

PERSONALS

Mr. F. C. Baluss has been appointed Engineer of Bridges and Buildings of the Duluth, Missabe & Northern R.R., with headquarters at Duluth, Minn.

Mr. Harry J. Marks, M. Am. Soc. M. E., Manager of the New York City office of the American Engine & Electric Co., has been promoted to be Sales Manager of the company.

Mr. J. N. Olson, Jun. Am. Soc. C. E., formerly Office Engineer of the J. C. Field Engineering Co., Denison, Tex., has been appointed Assistant City Engineer of Denison

Prof. H. C. Ramsower, of the college of agriculture of the Ohio State University, has been appointed the head of the new department of agricultural engineering of the college.

Mr. W. C. Barrett, formerly Special Road Engineer, Grant District, Jacksonburg, W. Va., has been appointed Division Engineer of the Lehigh Valley R.R., with office at Sayre, Penn.

Mr. R. F. Kelker, Jr., recently Assistant Engineer, Division of Valuation, Interstate Commerce Commission, has been appointed Traction Expert of the Bureau of Public Service of Chicago, Ill.

Mr. A. B. Copley, Division Superintendent of the Chicago, Rock Island & Pacific Ry., at Little Rock, Ark., has been promoted to be Assistant General Manager, with headquarters at El Reno, Okla.

Mr. W. A. Whitney, former Division Superintendent of the Southern Pacific Ry. at Sacramento, Calif., has been appointed General Superintendent of the Oregon Short Line R.R., with office at Pocatello, Idaho.

Mr. Hans August Evald Conrad von Schon, M. Am. Soc. C. E., has resigned as Consulting Engineer in charge of construction of the new water-works of the village of Highland Park, a suburb of Detroit, Mich.

Mr. Charles F. Brush, M. Am. Inst. E. E., of Cleveland, Ohio, has been awarded the Edison Medal of the American Institute of Electrical Engineers for his inventions and developments in electric arc lighting.

Mr. M. J. Butler, M. Am. Soc. C. E., of Montreal, Que., has been appointed a valuation expert to examine into the physical aspects of the Montreal Water & Power Co., to succeed Mr. Ernest Belanger, M. Can. Soc. C. E.

Mr. Lincoln Breedlove, of Martinsville, Ind., a recent graduate of the University of Illinois, has been appointed Supervisor of and Lecturer in mechanical enginering courses at Roberts University, Constantinople, Turkey.

Mr. E. L. Adams, recently Assistant Signal Engineer of the Lake Shore & Michigan Southern Ry., has been appointed Senior Signal Engineer of the Division of Valuation, Interstate Commerce Commission, at Chattanooga, Tenn.

Mr. E. C. Noble, of Houston, Tex., has been elected President of the Altus, Lubbock, Roswell & El Paso R.R., a new railway which has 60 miles of road in operation and 86 miles of roadbed graded through the Panhandle of Texas.

Mr. George Weston, recently removed by Mayor Harrison of Chicago, Ill., from his position as the city's representative on the Board of Supervising Engineers (in charge of traction work), retains his position as Chief Engineer of the Board.

Dr. Robert H. Whitten has resigned as Librarian-Statistician of the Public Service Commission, First District, New York State, to become Secretary of the committee on city plan of the Board of Estimate and Apportionment of New York City.

Mr. I. M. de Varona, M. Am. Soc. C. E., whose resignation as Chief Engineer of the Department of Water Supply, Gas & Electricity of the City of New York was noted in our issue of July 9, has been granted a pension of $3500 per annum, or 35% of his former salary.

Mr. J. W. Mulhern, former Superintendent of the Pere Marquette R.R., at Grand Rapids, Mich., has been appointed Superintendent of the Northern division of the Chicago Great Western R.R., with headquarters at St. Paul, Minn., succeeding Mr. W. B. Causey, resigned.

Mr. Carl Rankine has been appointed Locating Engineer of the San Francisco municipal railway to be built from the San Joaquin Valley to the Hetch Hetchy damsite. Mr. Rankine has had several years' experience in location surveys for the Southern Pacific Co. in California, Oregon and Arizona.

Mr. T. H. Sears, Division Superintendent of the Atchison, Topeka & Sante Fé Ry., at Marceline, Mo., has been promoted to be General Superintendent with headquarters at Armarillo, Tex. He is succeeded as Division Superintendent at Marceline by Mr. R. H. Allison, former Trainmaster at Emporia, Kan.

Maj. R. W. Leonard, M. Can. Soc. C. E., has resigned as Chairman of the Canadian Transcontinental Railway Commission in order to devote his whole time to private business. The duties of the commission are to be taken over by the Commissioner of Railways, under whose supervision the construction work now under way will be completed.

Mr. Otto Holstein, formerly Superintendent of Transportation of the Guayaquil & Quito Ry. in Ecuador, has been appointed Superintendent of Transportation of the San Antonio, Fredericksburg & Northern R.R., with headquarters at Fredericksburg, Tex. Mr. Holstein was formerly in charge of operation of the Central Ry. of Peru.

Mr. John J. Brown, President of the village of White Plains, N. Y., has been appointed Manager of the recently completed Bronx Valley Trunk Sewer, at a salary of $2500 per annum. The sewer has been completed, but is not in operation because the city of Yonkers, N. Y., has obtained an injunction against the building of a disposal works within that city.

Mr. Alexander Johnson, Assoc. M. Am. Soc. C. E., has resigned as Chief Engineer of the Department of Bridges, New York City. Mr. Johnson has not been in good health for some time. He is a graduate of Sheffield Scientific School, Yale University, and has been connected with the New York City Bridge Department for 18 years. He is succeded by Mr. Austin Lord Bowman, M. Am. Soc. C. E., as noted elsewhere.

Mr. Albert J. Stone, General Manager of the Erie R.R., at New York City, has been elected Vice-President in charge of operation, with headquarters at New York. Mr. Stone entered the service of New York, Lake Erie & Western R.R. in 1858 as a messenger. With the exception of two years, 1902 to 1905, when he was General Superintendent of the Delaware & Hudson R.R., Mr. Stone has been continuously in the employment of the Erie R.R.

Mr. Ralph W. Perry, formerly Chemist and Engineer of Tests of the Michigan Central R.R., has leased the railway company's laboratory, which was used for testing materials during the construction of the Detroit River tunnel, new Union Station, and subsequent improvements at Detroit. The laboratory will now be conducted under the name of the Perry Testing Laboratory, and will be used by Mr. Perry for the general practice of a chemical, inspecting and testing business.

Mr. Daniel F. Fulton, for the past six years Assistant City Engineer of Yonkers, N. Y., has been appointed City Engineer, succeeding the late Samuel L. Cooper, M. Am. Soc. C. E., who died a year ago. Mr. Fulton is a graduate in civil engineering of Cornell University, class of 1903, and was first employed as Assistant to the late George W. Rafter, M. Am. Soc. C. E., Consulting Engineer, of Rochester, N. Y. Later he was with the Buffalo, Rochester & Pittsburgh R.R. In 1904 Mr. Fulton was appointed Assistant Engineer in the New York State Engineers' Department. From 1906 to 1908 he was in charge of Residency No. 1 on the Champlain Canal.

Mr. James H. Hustis, President of the New York, New Haven & Hartford R.R., will resign, it is reported, Aug. 15, to become President of the Boston & Maine R.R., which is to be entirely separated from the New Haven system. He succeeds Mr. Morris McDonald, who returns to his former office as President of the Maine Central R.R. Until his election as President of the New York, New Haven & Hartford R.R., Mr. Hustis was Vice-President and operating head of the Boston & Albany R.R., so that there is probably no railway man in the country more familiar with New England conditions, although few of Mr. Hustis' contemporaries are likely to envy him on account of his new office. According to the recently enacted law of Massachusetts the New Haven system must sell its holdings of Boston & Maine R.R. stock within three years, the State of Massachusetts reserving the right to buy during or after that time.

Mr. Austin Lord Bowman, M. Am. Soc. C. E., Consulting Engineer, New York City, has been appointed Chief Engineer of the Bridge Department of the City of New York, succeeding Mr. Alexander Johnson, Assoc. M. Am. Soc. C. E., resigned. Mr. Bowman is a graduate of Yale University, class of 1883. Following his college course he began engineering work and in 1885 was employed in the city engineering department of St. Paul, Minn. Later he was with the engineering departments of Minnesota & Northwestern R.R. and the Chicago, St. Paul & Kansas City R.R. Mr. Bowman returned East in 1887 to join the engineering staff of the Kings County Elevated R.R. in Brooklyn, N. Y. From 1887 to 1890 he was with the Norfolk & Western Ry., and from 1890 to 1895 he was Engineer and Superintendent of Construction for the American Bridge & Iron Co., of Roanoke, Va. In 1897 he opened an office in New York City as Consulting Engineer. From 1901 to 1907 he was Consulting Engineer of the Central R.R. of New Jersey, and since 1907 Consulting Engineer of the New York City Department of Bridges.

OBITUARY

Stuart S. Barnes, for many years Superintendent of Bridges and Buildings of the Evansville & Terre Haute R. R., died June 21, at his home in Sullivan, Ind., aged 77 years. He was born in Pennsylvania and was a veteran of the Civil War.

Brig.-Gen. Garrett J. Lydecker, Corps of Engineers, U. S. A., retired, died at his home in Detroit, Mich., July 9. He was born at Englewood, N. J., in 1843. He graduated at the United States Military Academy at West Point in 1864. He was retired from the army as a Brigadier-General in 1901.

Mrs. Julia A. Wellman, wife of Samuel T. Wellman, Past-President of the American Society of Mechanical Engineers, Chairman and one of the founders of the Wellman-Seaver-Morgan Co., died July 2, at the family home in Cleveland, Ohio. Mrs. Wellman is survived by Mr. Wellman and their two daughters and three sons.

Quimby N. Evans, M. Am. Soc. M. E., senior partner of the firm of Evans, Almirall & Co., Engineers and Contractors, New York City, died July 6. Mr. Evans began business in the early seventies in partnership with Frederick Tudor in Boston, Mass. In 1880 he formed the Q. N. Evans Co., of Boston and New York. Mr. Evans became associated with Juan A. Almirall, M. Am. Soc. M. E., in 1892, and two years later the present copartnership of Evans & Almirall was formed.

Melville E. Ingalls, former President and Chairman of the Board of Directors of the Cleveland, Cincinnati, Chicago & St. Louis Ry., died at Hot Springs, Va., July 11. He was born in Harrison, Maine, in 1842, and when 28 years old was made President of the Indianapolis, Cincinnati & Lafayette R.R.; later he was Receiver for the same railway. He was President of the reorganized company, and again Receiver of it, when it failed a second time in 1876. He was subsequently President of the reorganized and consolidated railways which became the Cleveland, Cincinnati, Chicago & St. Louis Ry. From 1888 to 1900, Mr. Ingalls was also President of the Chesapeake & Ohio Ry.

ENGINEERING SOCIETIES

COMING MEETINGS

OHIO ELECTRIC LIGHT ASSOCIATION.
July 16-19. Annual convention at Cedar Point, Ohio. Secy., D. L. Gasgill, Greenville, Ohio.

AMERICAN ASSOCIATION OF RAILROAD SUPERINTENDENTS.
Aug. 20-21. Annual meeting in New York City. Secy., E. H. Harman, Room 101, Union Station, St. Louis, Mo.

AMERICAN PEAT SOCIETY.
Aug. 20-22. Annual meeting at Duluth, Minn. Secy., Julius Bordollo, 17 Battery Place, New York City.

AMERICAN BOILER MANUFACTURERS' ASSOCIATION.
Sept. 1-4. Annual convention in New York City. Secy., J. D. Farasey, E. 37th St., and Erie Ry., Cleveland, Ohio.

AMERICAN MINE SAFETY ASSOCIATION.
Sept. 7-10. Annual meeting in New York City. Secy., H. M. Wilson, Bureau of Mines, Pittsburgh, Penn.

NATIONAL ASSOCIATION OF PORT AUTHORITIES.
Sept. 8-10. Annual convention in Baltimore, Md. Secy., Wm. Joshua Barney, 29 Broadway, New York City.

ROADMASTERS AND MAINTENANCE OF WAY ASSOCIATION OF AMERICA.
Sept. 8-11. Annual meeting at Chicago, Ill. Secy., L. C. Ryan, Sterling, Ill.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION.
Sept. 8-11. Annual convention in Nashville, Tenn. Secy., A. P. Dane, Reading, Mass.

NEW ENGLAND WATER-WORKS ASSOCIATION.
Sept. 9-11. Annual convention in Boston, Mass. Secy., Willard Kent, Narragansett Pier, R. I.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.
Sept. 15-18. Convention in Atlantic City, N. J. Secy., Clayton W. Pike, Electrical Bureau, Philadelphia, Penn.

ILLUMINATING ENGINEERING SOCIETY.
Sept. 21-25. Annual convention in Cleveland, Ohio. Secy., Joseph D. Israel, 29 W. 39th St., New York City.

RAILWAY SIGNAL ASSOCIATION.
Sept. 22-24. Annual convention in Bluff Point, N. Y. Secy., C. C. Rosenberg, Times Building, Bethlehem, Penn.

Atlantic Deeper Waterways Association—The eighth annual meeting of the Association will be held in New York City, Sept. 8-12. After the first day's session an inspection of New York harbor and of the New York and New Jersey waterways will be made. For the remainder of the convention the delegates will be housed aboard the Hudson River boats, on which the remaining sessions will be conducted. Representative J. Hampton Moore is President of the Association.

American Peat Society—The eighth annual meeting will be held Aug. 20-22, at the Commercial Club, Duluth, Minn. There will be an excursion to two peat-bog districts some 40 miles north of the city, in one of which large drainage ditches are being cut to prepare the land for agricultural use. The papers will cover the cultivation and drainage of peat lands, and the commercial uses of peat. Some of the papers are as follows: "The Peat Gas Producer," F. B. Haanel, Ottawa, Can.; "The Possibilities of Peat in Smelting Iron Ore," Prof. Peter Christiansen, University of Minnesota; "Converting Peat Into Fuel," Charles A. Davis, U. S. Bureau of Mines; "Peat Briquetting," J. McWilliam, London, Can.; "Briquettes from Peat and Petroleum," Robert Blei, Sacramento, Calif.; "The Herbsin Briquetting Machine," C. A. Squire, Cleveland, Ohio; "Application of Machinery on Peat Deposits," L. A. Krupp, Findlay, Ohio; "Preparing a Peat Bog for Fuel Making," Gustave Carlson, Farnham, Can.; "Peat Lands in Minnesota and Wisconsin," Prof. J. T. Stewart, University of Minnesota; "The Peat Situation in Minnesota," Max Toltz, St. Paul, Minn.; "Economic Aspect of Peat in America," John N. Hoff, New York.

Other papers will deal with the peat industry in England, Ireland and Russia. An exhibit of peat, peat products, briquettes, machinery, etc., photographs of work, and other matters pertaining to peat development, will be displayed at the rooms of the Commercial Club, July 25-Aug. 22. Further information may be had from Julius Bordollo, Secretary, American Peat Society, 17 Battery Place, New York, N. Y.

Engineering Literature

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CORRESPONDENCE

A Book Purchaser on Title-Page Dates

Sir—In your issues of Dec. 18, 1913, Jan. 15, Feb. 12, and Mar. 19, 1914, you comment upon "Title-Page Dates," particularly upon the misrepresentation involved in a change of title-page date when there is substantially no change in the text.

May I call your attention to a flagrant case of such misrepresentation? I refer to "Electric Power Conductors," by Del Mar, "Second Edition Revised." I ordered this book, misled by the advertisement, thinking it to be a new edition, but in ordering it I warned the company supplying it that I should return it if it were not really a second edition, stating that I had frequently been swindled by fake second editions.

My attention was first attracted by the preface to the "second edition," signed by the author, reading as follows:

> The specifications for rubber insulation are radically different from those of the first edition and represent the results of a great deal of investigation and research. Other changes of more or less importance will be found on nearly ten (10) per cent. of the pages of the book.

This led me to inspect the book with some care. The first inspection revealed no changes other than those in the specifications for rubber insulation, but a further examination made with considerable care brought to light the following changes:

On pp. 13, 46, 49, 101, 124, 302 and 307, the addition of a footnote on each.

Pages 82, 83 and 251, rewritten in part.

Page 294, formulas changed.

Pages 317, 318 and 319 rewritten.

While I am not prepared to say that this covers absolutely every trifling change in the book, yet I believe it does substantially. You will note that there are practically no changes in the book save those referring to the changes in the "Rubber Specifications," which are included in pp. 189-92 and pp. 317-19.

Under these circumstances, it is difficult to see what justification there is either for the preface to the "second edition" or the change in the title page and the caption "second edition revised." The book is not a second edition; it is a first edition with very slight revisions and it is a gross misrepresentation to pretend that it is anything else.

I have frequently in the past been deluded into buying valueless technical books by practices of this kind, and I think it time that a strong protest be made against this sort of thing.

CARY T. HUTCHINSON.

60 Wall St., New York City,
June 19, 1914.

A Handbook of Fan Engineering

Sir—The writer is much disappointed with the review (ENGINEERING NEWS, June 18, 1914), which you have given to the "Fan Engineering Hand Book," published by the concern with which he is associated. He feels that your remarks convey a wrong impression to the reader and, inasmuch as the company is selling the book at $3 per copy, he cannot but feel that there will be confusion created in the minds of those of your readers who may see the advertisements of this work.

The writer must take exception to your statement that it is partly fundamental theory, partly a statement of common practice and much from the company's files, not because these items are not included, but because your comment implies there is nothing else to the work. There is included in this book much that is new to the fan engineer and it is information which is not limited in application to one concern's apparatus. Therefore it is left that the claim is substantiated for the book as a decided step forward and to be recognized as a true text or reference book on the subject.

H. C. RICE.

Buffalo Forge Co., Buffalo, N. Y., July 7, 1914.

A puzzling bit of railway English is circulating at the rate of some hundreds of miles a day on a railway south of Mason and Dixon's line. It reads:

> Passengers are respectfully requested to keep their feet off the seats.
>
> Conductors are instructed not to permit this.

Notwithstanding this sign, the seats did not look footworn nor the passengers nor conductor careworn.

REVIEWS AND NOTES

Irrigation in Egypt

REVIEWED BY F. H. NEWELL*

EGYPTIAN IRRIGATION—By Sir W. Willcocks, Formerly Adviser to the Ministry of Public Works, Constantinople; Managing Director of the Daira Sania Company, and Director-General of Reservoir Studies, Egypt, and J. I. Craig, Director Computation Office; Director Meteorological Section, Egyptian Survey Department; now Controller, Department of General Statistics, with an Introduction by Sir Hanbury Brown, formerly Inspector General of Irrigation, Egypt. Two volumes. Third edition. London: E. & F. N. Spon, Ltd. New York: Spon & Chamberlain. Cloth; 7x10 in.; pp. xxxiv + 884; 188 illustrations and 81 folding plates. 15, net, per set.

American engineers, particularly those having to do with water-supply, irrigation or drainage, will find much of interest in the recent, the third, edition of "Egyptian Irrigation" prepared by Sir William Willcocks and J. I. Craig. This interest is aroused both by the similar and by the contrasting conditions between those in Egypt and in the United States.

Under the head of similar conditions which afford lessons of direct application are the problems of storage of flood waters, of disposing of silt, of guarding against excessive use of water and consequently of alkaline conditions, of the necessity of fertilization, not merely for immediate increase of crop production but also as saving waste of water, and in pumping water both as a supplemental supply and as the only source of irrigation water.

The contrasting conditions which are also valuable, though of less direct application, are the regularity of flow of the river, the unity of the problem—as the water is derived from the one drainage area—the method of application of the water in great basins, the labor conditions, the character of land ownership, and the financing of the works and recovery of the cost by taxation.

The book itself, of two volumes, aggregating nearly 900 pages, with maps and illustrations, is largely a compilation of official reports. While this form of presentation has its advantages in showing the development of ideas and in affording opportunity of reference to these early reports, yet to a stranger it has the great disadvantages of repetition, of unnecessary elaboration, and of more or less confusing arrangement. The man who thoroughly understands the subject can readily add to his knowledge through such profusion of detail and by occasional divergency of view expressed, but to a busy engineer the task of digging out some of the larger elementary facts is discouraging. The value of the book could be greatly increased to the engineering profession in general if more elementary explanations were given as to the local customs and terms, also by having simple conversion tables showing the relation between the units of quantity, areas and values, with those habitually employed in other countries, notably in the United States.

Surmounting these barriers to easy progress, however, the irrigation engineer finds much "pay-dirt" scattered through the book. It begins with a general description of Egypt and the Nile, then takes up the basin irrigation which has been practiced for thousands of years, followed by more modern perennial irrigation which has become possible through the building of barrages, or as we term them diversion dams. Next comes the important subject of drainage and land reclamation, together with the engineering details of the barrages, storage reservoirs, flood protection and agricultural conditions. One of the most striking of these is a statement repeated from an early report, "The Nile in 1904," as follows:

> It would be a healthful innovation, indeed, if the provision of suitable manures were to be considered as an essential part of a project for providing perennial irrigation. The day is not far distant, I believe, when governments which provide irrigation works will also provide manures, and sell the water and the manures together, one being as essential as the other. I know well, from observation, that a well manured field needs only half the water that a poorly manured field does; and in years of drought and scarcity manures almost take the place of irrigation. Why should there not be a manure rate as well as a water rate? Here in Egypt, the numerous ruins of old-world cities have hitherto provided manure for a great part of the perennially irrigated lands; but these are being fast worked out and other sources must be sought for. Farmyard manure will never suffice for the intense cultivation in this country.

Compared with conditions in the United States, irrigation in Egypt appears to be a relatively simple problem, although one of great magnitude. To the outsider it appears at first glance that all that is needed is ample money to build a few big storage dams and to divert the water into large canals from which it could be distributed over millions of acres. Going deeper into the matter, however, it seems that this broad requirement is complicated by a number of conditions, not at first apparent even to the men who have been on the ground. The fundamental difficulty encountered throughout the world is that whenever an ample supply of cheap water is provided by storage the lands are over-irrigated quickly and a large part of them ruined by excessive application of water. In the United States this danger is being met by delivering water for irrigation on a measured basis; that is to say, by selling the water or charging the cost of delivery on the basis of so much per acre-foot. In this, the ordinary commercial rules are followed, as in the sale and delivery of coal or any other commodity. Through the *pocket nerve* it is thus possible to secure economy of water and save good land from destruction, even where every other argument fails.

In storing and diverting the water of the Nile there have arisen not only the evils of swamping the lands and of accumulating salts or "alkali" on the surfaces, but also the deprivation of much of the land of the rich red water renowned throughout all time for its fertilizing qualities. It is not enough merely to obtain water for the land; to secure the highest results the water must carry and leave on the fields the red mud which comes mainly from the Blue Nile and other tributaries rising in the mountains of Abyssinia. These floods of red water occur with marvelous regularity and have been the cause of the agricultural success in the Nile Valley for upward of 7000 years. The time of occurrence of the red water is relatively short; throughout the rest of the year the water, though valuable, does not bring with it the elements of fertility comparable with those of the red-water period.

It is obvious that this rich red water cannot be held in storage but at the time of occurrence must be passed on directly to the fields and the distribution system so arranged that not only will ample water come to the fields but there must be provision for rapid escape of much of the water after it has deposited the red mud on the fields. This is a condition, emphasized by the present book, which has not been fully appreciated even by some of the

*Director, United States Reclamation Service, Washington, D. C.

administrative officers who have had responsible charge of the planning and operation of the works. They have either overlooked or minimized the value of this red water or have not provided ample capacity for bringing it to the fields or for carrying the water away after it has deposited its burden.

The problem of the most complete use of the Nile is further complicated by certain peculiar topographic conditions which are not usually appreciated. The problem is not a simple one of storing all the water possible in large reservoirs near the headwaters and letting it down when needed. The best reservoir sites do not occur where the water can be stored to best advantage. This is almost invariably the case in every country. In addition, is the peculiar topographic condition that down along the lower course of the river shortly before it branches at the delta, there is in the desert to the west of the river a series of deep depressions the bottoms of some of which are below sea level. In this respect the contour of the country is somewhat similar to that of the Salton Sea area in Imperial County, southern California, west of and above the delta of the Colorado River.

It is possible to divert the floods of the Nile, as in the case of the Colorado River, to these basins in the west. This is by no means a modern discovery. The conditions were not only known to the ancients but the early Egyptian engineers and rulers actually built works for diverting the high Nile floods into these basins, thus protecting the lower lands from inundation. These works were of such magnitude that it has long been a question as to whether the remains now existing were actually built by the hand of man. They rival the building of the pyramids and far surpass these in grasp of engineering laws and in value to the country.

The ancient rulers not only diverted the extraordinary floods for purposes of preventing inundation but by filling one of these basins to the level of high Nile were able to draw back into the lower river a certain amount of water when the floods subsided. In this respect they had certain advantages over the modern plans which contemplate using one of these basins for escape or relief to the extraordinary floods but which on account of the topography cannot return the water to the river at low stages as was formerly done. The basin which was then used and which could deliver back to the river some of the stored water, is now being cultivated to an extent that it is not practicable to utilize it again for water storage.

Passing from these larger engineering conceptions, the book deals with many important administrative problems, notably with reference to control of the use of water to prevent deterioration of the land. In this respect, the Egyptian government is autocratic and can and must enforce the regulations devised by its experienced advisors. It need not await the slow education of the great body of water users before adopting those practices which experience has shown are necessary for the general prosperity. The book emphasizes the well known saying that "the Egyptian question is the irrigation question; without irrigation there can be no Egyptian people; certainly no civilization in Egypt."

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Bulletins on the Results of Spirit Leveling in Kansas, Washington and Oregon, from 1896 to 1913, inclusive, have been published recently by the U. S. Geological Survey, Washington, D. C.

THE MUNICIPAL YEAR BOOK OF THE UNITED KINGDOM for 1914—Founder and Director, Robert Donald. Editor, Albert E. Cave. London: The Municipal Journal, Ltd., Sardinia House, Sardinia St., W. C. Cloth; 6x9 in.; pp. 1193. 15 Shillings, net.

A vast amount of information regarding the municipalities and municipal activities of England, Wales, Scotland and Ireland is given in this thick volume. Besides lists of council members, "chief officers" and a variety of descriptive, historical and general information under each place listed, there are given many facts and figures regarding water-works, gas works, electricity supply, tramways, refuse and sewage disposal, housing, town planning, baths and wash houses local taxation, financial transactions of municipalities for 1912-13, and other subjects. This plan is convenient when looking for information on a single topic, as water-supply, but it scatters the information for a given city all through the book. However, such a storehouse of municipal data is a boon, however arranged, and this volume is systematically arranged and well indexed. Services rendered by private companies are not even mentioned.

⁂

The 1913 American Year Book

THE AMERICAN YEAR BOOK: A Record of Events and Progress, 1913—Edited by Francis G. Wickware, under Direction of a Supervising Board Representing National Learned Societies. New York and London: D. Appleton & Co. Cloth; 5x8 in.; pp. xx + 892. $3.

An incorporated Supervisory Board of 39 members, representing officially or unofficially 39 learned societies, has directed 128 contributors in the preparation of this, the fourth, issue of "The American Year Book." The large mass of information given is classified and subclassified under 35 departments.

The departments of most direct interest to the readers of this journal are: Municipal Government; Public Resources and Public Works; Public Services; the Mineral Industries; Trade, Transportation and Communication; Engineering, Mathematics and Astronomy; and Chemistry and Physics. In addition, history, government, foreign affairs, population and a variety of other large subjects are treated.

In such a reference annual as this, of course, the information given in any one department is not designed for specialists in that field, but rather for those in other fields and for laymen. From this viewpoint the 35 pages devoted to Engineering and the 8 pages given to Civil Engineering may perhaps be considered sufficient, at least in relation to the 860 pages which comprise the book. It should be noted, however, that many of the subtopics treated under Engineering appear in one to three or four departments—partly as additional information and partly as repetition.

Where space limitations compel such light touching on the high peaks as is noticeable in this volume the departmental repetition seems questionable. As an example of questionable repetition the proposed Hetch Hetchy or Tuolumne River water-supply for San Francisco may be cited. This has a short paragraph under Legislation (p. 27), nearly a page under Public Resources and Public Lands (p. 270), a paragraph under Public Services (p. 304), and another paragraph under Water-Supply (p. 581). Altogether, Hetch Hetchy gets considerably more than a page in these four places. Some of the information under Civil Engineering is both duplicated and seemingly contradicted under Public Services, in the references to the killing of the New York

water-filtration project; and a resumé of water disinfection by chlorination appears under both Civil Engineering and Sanitary Chemistry, with somewhat misleading statements in each place. The blemishes cited are minor ones and might not deserve mention if they did not come in duplicated matter.

The mystery surrounding the non-representation of the American Society of Civil Engineers on the Supervisory Board still remains unexplained. It is all the more noticeable when one finds four or five other national engineering societies and the American Institute of Architects represented.

Tests of Bond between Concrete and Steel

TESTS OF BOND BETWEEN CONCRETE AND STEEL—By Duff A. Abrams. Bulletin 71, Engineering Experiment Station, University of Illinois, Urbana, Ill. Paper; 6x9 in.; pp. 238; illustrated. $1.

The nature and extent of the bond between reinforcing and concrete in reinforced-concrete beams has been the subject of experimental investigation ever since reinforced concrete has come into very extensive use, and a number of series of such experiments have been reported in serial publications and in laboratory bulletins. The bulletin before us, however, is by far the most elaborate of any such publications we have seen, and the tests on which the bulletin is based seem to be more extensive than any hitherto made. The bulletin is by D. Abrams, Associate in Theoretical and Applied Mechanics of the Engineering Experiment Station at the University of Illinois, and the tests on which the bulletin was based were made in the Laboratory of Applied Mechanics of the University of Illinois between 1909 and 1912, under the direction of Prof. A. N. Talbot. The experiments were made on straight pull-out specimens and on beams of various design and dimension, with different types and sizes of reinforcement.

The report of the tests is very much too long to abstract here, and the results obtained are equally extensive. In fact, the author requires 101 paragraphs to summarize the results as analyzed by him. We give below, however, the various headings under which the investigations were made, so that the reader may get some idea of the extent of the investigation.

Under the pull-out tests the subheads are: The effect of variations in the dimensions of pull-out specimens, the effect of shape and section and condition of surface of bar, effect of condition of storage, bond tests with deformed bars, effect of age and mix, effect of anchoring ends of bars, and miscellaneous tests.

Under reinforced-concrete beam tests, each of the three-years' tests are taken up separately, under such headings as bond with plain round bars, bond with deformed bars, comparison of bond resistance in beams and in pull-out tests, effect of vertical stirrups on bond resistance, effect of depth of concrete below the reinforcement, effect of span lengths, effect of length of overhang and ends of beams, theory of reinforcement, effect of repeated and continued load on beams, slip of reinforcing bar at internal points in beams, distribution of bond and tensile stress along the bar, relation of slip of bar to diagonal tension cracks, influence of slip of bar upon beam deflection, critical bond stresses, and working stresses for bonds.

Enough has been given, we are sure, to indicate to the reader how valuable a contribution to the theory of reinforced-concrete design Mr. Abrams and his associates have made.

Coast Sand Dunes

COAST SAND DUNES, SAND SPITS AND SAND WASTES—By Gerald O. Case, Consulting Engineer for Coast Works. London: St. Bride's Press, Ltd. Cloth; 5x8 in.; pp. 162; 43 illustrations. 5 shillings, net.

A large part of the shores of the oceans and large lakes of the world, is lined with sand, which, under natural conditions, is a moving body, subject to the forces of wind and wave, and often a serious danger to inshore life and structures. In the older countries of the world considerable effort has been made to fix this sand and to prevent its movement in so far as possible. This has been done by the construction of groins extending out into the water and by the planting of various local trees and bushes on the foreshore itself. Some of this work has been done in the United States and in England, but most of it in Continental Europe.

So far as we know, there has been very little published in the English language which would help an engineer in preparing the design for such protective works. Mr. Case has, therefore, in the little book which is before us, filled a gap in English technical literature.

The book is exceedingly well written, and should be quite interesting to any engineer, even though he has not in prospect the construction of shore-protection work. It describes in some detail the nature of sand dunes and formations throughout the world, explains the movement and the forces behind the movement of the sand, and outlines somewhat extensively the damage which can be done by the sand movement. The latter part of the book is devoted to the various methods of protection which have been utilized in different specific cases. While quite a good deal of the book is devoted to the groin construction, far more is concerned with the planting of trees and bushes.

THE PANAMA CANAL—By Frederic J. Haskin, author of "The American Government," etc. Garden City and New York: Doubleday, Page & Co. Cloth; 5x8 in.; pp. x + 386; illustrated. $1.35, net.

This is one of the many popular books on the Panama Canal which has appeared recently. The author is a well known newspaper correspondent and is able to write in a very entertaining manner. The book is based on facts taken from the official Panama Canal *Record* and illustrated by reproductions of official photographs, and therefore, so far as engineering data go, is accurate; indeed, the chapters on engineering features have Col. Goethals' endorsement.

It is a book intended for laymen and not for engineers, and is written in the breezy newspaper style of superlatives, with which all are familiar. It is unfortunate for the fame of other engineers that the same public enthusiasm cannot be generated for great engineering projects nearer home.

CHEMISTRY IN AMERICA: Chapters From the History of the Science in the United States—By Edgar F. Smith, Blanchard Professor of Chemistry, University of Pennsylvania. New York and London: D. Appleton & Co. Cloth; 5x8 in.; pp. viii + 356; illustrated. $2.50, net.

Before the author became Provost of the University of Pennsylvania, he was in great demand for remarks on

the development of chemistry and for lectures in the classroom and out of it. Much more from the original sources of Prof. Smith's various addresses have been presented in this printed form than could be given in the limits of any set of lectures. He quotes some papers left by a few men of investigative nature in colonial days and outlines the activities of the Philadelphia Chemical Society (1792). Certain eminent pioneers are the subject of biographical sketches—informally and with regard to their works rather than their lives. Among these, memoirs of James Woodhouse, Thomas Cooper, John Maclean, Robert Hare and Benjamin Silliman, occupy considerable space and a score of others are crowded into smaller compass.

Thought and Method in Administration

REVIEWED BY EDWIN R. DOUGLAS*

BUSINESS ADMINISTRATION; Its Models in War, Statecraft and Science—By Edw. D. Jones. New York: The Engineering Magazine Co. [Works Management Library.] Cloth; 5x8 in.; pp. vii+275. $2, net.

The argument for this book is given in its first chapter. Considering briefly the industrial history of the United States during the times of the pioneers and of the development of mechanism, the author passes to the present beginning of the age of administration. Regarding this he comments substantially as follows:

The executives who first took advantage of conditions were self-made men, captains of industry. Their era has been marked by a lack of clear distinction between the process of amassing a fortune and the requirements of administration.

There is now being introduced into industry the judgment of the action itself, regardless of the personal reward which may have been received. "Scientific Management," which took its rise as a philosophy of the shop, has culminated in a group of principles constituting an earnest of a forthcoming science of administration. There is being created a central strategic position to be occupied by the professional administrator.

A new and larger conception of industrial leadership is called for. Society is no longer satisfied to trust, for its administrators, to processes of "learning through experience." What is wanted is a body of principles of industrial action.

The remainder of the book is devoted to a study of those general principles of administration revealed by military and political history, science and diplomacy. The records are full of achievements in these fields and to them we are confined, for the Captains of Industry have been too much occupied to formulate and record the principles by which they acted.

Under the headings, "The Administrator as General—as Scientist—as Diplomat," these three branches of human effort are studied in turn, historically and analytically. The principles discovered are, by analogy, applied to business administration. As stated, they range from Decision, Initiative, Preliminary Planning, through Economy of Means, Openmindedness, Fertility of New Viewpoint, to Courtesy, Compromise, Just Proportion; about two dozen altogether.

Opinions may differ as to a list like this, particularly as a statement of principles; there will be little question as to the unity of the underlying principles in all forms of administrative effort. A chief merit of the book is in bringing this fact prominently to the mind, and in emphasizing the importance, to the coming Business Administrator, to his business, and to society, which he will serve, of a broad foundation in generalship, scientific method and diplomacy. The book is an exposition of Thought and Method in administration.

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REGULATION OF PUBLIC SERVICE COMPANIES IN GREAT BRITAIN, With Supplemental Chapters on the Boston Sliding Scale and Toronto Auction Sale and Maximum Dividend Plans—By Robert H. Whitten, Librarian-Statistician, Public Service Commission for the First District, State of New York (154 Nassau St., New York City). [Reprint of Appendix G, Annual Report of the Commission for 1913.] Paper; 6x9 in.; pp. 231.

Mr. Whitten recently completed for the National Civic Federation a six-months' study of the regulation exercised in Great Britain over public utilities. The material gathered forms the basis of a lengthy dissertation, a readable "story" virtually, which the Public Service Commission for the First District of New York (with which Mr. Whitten was connected) has printed as an appendix to its 1913 report.

While the report is a study of regulation as a whole—as affecting organization, rights, capitalization, vested interests, voting powers, operation, accounting, dividends, etc.—the greatest interest centers on some aspects of British regulation greatly at variance with our own practice—lack of general regulatory acts and the number of special bills, sale of new stock by auction and tender, retrogressive scales of voting power, outside audits, dividing scales to govern rates and dividends. A large part of the volume is taken up with the last topic. British acts embodying it are reprinted and such information as is available on the practical operation. With this is also a review of the arguments on both sides of the water as to the proportion of division of excess profits.

MODERN CITIES; Progress of the Awakening for Their Betterment Here and in Europe—By Horatio M. Pollock and William S. Morgan. New York and London: Funk & Wagnalls Co. Cloth; 5x8 in.; pp. x+418; illustrated. $1.50, net.

The authors have brought together in a series of chapters on such topics as city planning, city streets, art in cities, parks, harbors, government and education a considerable amount of readable information relating to what they term "social progress and civic betterment" and "the best modern features and ideals of American life." Frequent reference to conditions and achievements in foreign cities are based largely on an extensive European tour made in 1910. The book contains some useful facts and statistics but these appear to have been chosen to enforce the argument for municipal betterment rather than to be of direct practical use in bringing it about—which is not a fault in a book which is primarily inspirational in character.

A report on the "Fourth General Adjustment of the Precise Level Net in the United States and the Resulting Standard Elevations," by William Bowie, Inspector of Geodetic Work and Chief of the Computing Division, and H. G. Avers, Computer, U. S. Coast and Geodetic Survey, has just been issued. This is the authority on precise spirit leveling and should be included in the library of every engineer interested in this branch of engineering. Besides a description of the instruments, methods of fieldwork, computation, etc., the report contains

a revised list of precise level benchmarks, with their descriptions and adjusted elevations, all through the United States. The advantages of tying local survey nets into the national precise level net is not fully appreciated by many engineers and surveyors; yet it is the only way in which a city datum may be settled once and for all.

A Public-Health Compendium

PREVENTIVE MEDICINE AND HYGIENE—By Milton J. Rosenau, Professor of Preventive Medicine and Hygiene, Harvard University; formerly Director of the Hygienic Laboratory, U. S. Public Health Service. New York and London: D. Appleton & Co. Cloth; 6x9 in.; pp. xxviii + 1074; 157 text illustrations. $6.

The modern spirit of health-protective work is reflected in both the title of this admirable book and in the order of presentation of its two grand divisions. That is to say, the author first takes up the prevention of specific diseases, particularly those which are communicable. This done he considers environment in relation to health and disease. The author presents his vast mass of information in the illuminating and discriminating light of long and varied experience in the Federal health service, both field and laboratory, and in the university classroom. The facts so compiled and presented, the author states, "have been collected for the convenience of the student of medicine and the physician, as well as those engaged in sanitary engineering or public-health work."

That the task which the author set for himself was a large one, demanding unflagging industry and keen judgment through many months is evident from the program just outlined and still more evident from the book itself. The latter part of the foregoing statement will be better appreciated after giving a brief summary of the contents of the volume.

First of all, the various communicable diseases are considered separately, grouped according to modes of transference from person to person, as by alvine discharges, nose and mouth discharges and insects. Besides modes of transmission, resistance, immunity, prevention and general considerations are all taken up for the more important diseases.

Following the section of communicable diseases, which fills 336 pages, 121 pages are devoted to immunity, heredity and eugenics; 113 to foods, including milk and its sanitary control; 48 to air, which embraces sewer air and ventilation and heating; 21 pages to soil and its relation to disease; 112 to water, including composition, sources, analysis, purification and relation to disease; 26 to a rational treatment of sewage disposal and 4 to refuse disposal, both by Prof. Geo. C. Whipple; 35 to the very important subject of vital statistics, by Dr. Cressy L. Wilbur; 33 to industrial hygiene and diseases of occupation; 20 to schools; and, finally, the book closes fittingly with 68 pages on ventilation.

The mere fact that Dr. Rosenau's book is the most recent comprehensive survey of the whole field of public health goes far toward placing it ahead of anything else on the subject in the English language. Add to this that the plan of the book is better suited than the older ones to the needs of the day, and that the plan has been well executed, and the leading position of the book is assured.

Although the statements in the foregoing paragraph are made ungrudgingly—in fact, with pleasure—we cannot refrain from suggesting that a smaller book might be more serviceable and that this and other huge treatises on public health might be made shorter by one or both of two methods: (1) By not repeating so much already in print in a score or several score books, and (2) by not trying to make one and the same volume serve the physician and the engineer. We are well aware that the classroom lecturer and the textbook writer must repeat many oft-told tales and that there is a considerable demand for what may be termed the single encyclopedic volume. If the engineer and doctor, in embryo or in practice, are to be served by a single book, would it not be better to treat each branch of the subject with relative brevity, dealing chiefly with principles and referring to existing works for most of the detail?

As an illustration of the briefer treatment, Prof. Whipple's four pages on refuse disposal may be cited. In those pages he tells all that most doctors need to be told on this subject and enough to serve many engineering students. The engineer who wants much more information might better go to some of the books cited at the end of the chapter—although the most recent book is omitted; an unfortunate omission, because it is a British book and the British lead the world in refuse destructors.

Another pertinent question is whether in this or any other book of as wide a range, collaboration should not be practised to a larger extent than was done in the present case, thus lessening the time required to prepare the book and making it more uptodate when published, besides lessening the volume of matter that is sheer compilation and giving more from the pens of specialists in the subjects treated.

Such questions as we have raised are not designed to belittle the value of Dr. Rosenau's monumental work. If he set himself a hugher task than some may think to have been necessary, no one can deny that he planned and executed it most admirably and that he deserves high credit both for the magnitude and character of his accomplishment.

HEAT—Prepared in the Extension Division of the University of Wisconsin by E. M. Shealy, Assistant Professor of Steam Engineering, University of Wisconsin. [Engineering Education Series.] New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xi + 262; 110 text illustrations. $2, net.

In connection with the extension teaching of the University of Wisconsin, a series of elementary texts of unique merit is being built up, and this addition to the list maintains the degree of excellence attained by earlier volumes. Prof. Shealy has given here an exposition of heat phenomena and their common application, for men in mechanical pursuits but of limited education in physics particularly. Such a treatise should also be of service to a great many engineers who years ago have forgotten the details of the physics of energy reactions, on account of their mental preoccupation in construction.

The first part covers temperature effects and measurements. A following chapter distinguishes between force and work and describes an elementary steam engine. Then energy and power are differentiated. From here on, heat phenomena are directly involved—generation, transference, development of pressure in gases, effect of compression and expansion, properties of vapors. This completes what might be called Part One, though there is no such formal division. From here on, machinery and commercial processes are described. The steam engine is described in further detail; air compressors and explosion engines are briefly passed over; chapters on modern refrigeration and house heating close the work.

British Utility Management

THE MANAGEMENT OF PUBLIC ELECTRIC SUPPLY UNDERTAKINGS—By A. Hugh Seabrook, General Manager, St. Marylebone Electric Supply; formerly Engineer and Manager, and subsequently Consulting Engineer, West Ham Electric Supply. London: "The Electrical Times," Ltd. Cloth; 6x10 in.; pp. 192. 7½ shillings, net.

Mr. Seabrook is a British utility engineer and his dissertations in this volume were intended for British managers, who labor under conditions quite different from our own. But what is said of English utilities as they are and as they might better be, is, nevertheless, of interest to American managers. Moreover, not all conditions are so unique in the British Isles that we cannot profitably study the utilities there.

The book is based on lectures to technical students but it is of greatest interest to men active in the industry. The earlier parts of the book are very general—Chapter I pleads for better public relations and Chapters II and III discuss the burning questions of industrial employment. After about a fifth of the book is passed through for such matters, the writer confines himself more to the electricity-supply field.

First, the advantages of electric service are pointed out alluringly "to emphasize the importance of good and efficient management." The author argues that the best service comes from private companies under municipal regulation.

The organization of an undertaking with a plant of about 20,000 kw. capacity is described—embodying the author's ideas of a general manager and chief engineer (one person) under a "board of management" and over a secretary-accountant, generating engineer, mains engineer and sales manager, each with a complete staff. Yet in discussing organization, the author seems to admit that these four colleague deputies must be a wholly sympathetic quartette filled with the spirit of coöperation or else the big boss of all must never fall ill or go away. The scheme will be criticized on both sides of the pond by those who have achieved success with say two deputies and an automatic succession down the line to the mantle of authority in the absence or illness of those higher up.

The main office for this undertaking is described in detail—if this were more than a dream, employment with this concern would be most alluring. It is on the main street; there are revolving doors and a "smartly uniformed commissionaire" selected for marvelous politeness and intelligence. There is a "spacious waiting room comfortably but not luxuriously furnished"; a few daily newspapers and reference books are to be seen there, and, in the background, catalogs and advertising literature. There are consultation rooms and show rooms—and everything worked by electricity. All this for the 20,000-kw. concern!

The ideal General Manager is described as a man of most wonderful make-up—naturally humane, patient, tactful, polite, forceful, inspiring, fair, receptive, well educated, quick of perception and decision and, last but not least, thoroughly trained in engineering and versed in law and finance. We are warned that unless the man is both a commercialist and an engineer he will fail. We wonder what salary would attract such an intellectual giant to the 20,000-kw. company.

Some 40% of the volume following, sets forth in much detail the organization and working of the four deputies' departments. Here is a fine place for some of our organization and efficiency experts to seek work if British plants really are run this way; for instance weekly statements of detailed costs (of dubious utility) are compiled and there is a monthly analysis of connections and disconnections even down to every fan, cooker and curling iron. There are some technical matters of peculiarity, like the preference for "drawn in" underground mains (even though there may be frequent customer connections), single-conductor in place of concentric-conductor cables, and elevated connection posts wherever possible. Yet most of the discussions awaken an approving response.

The last forty pages are devoted to rates (or, as our cousins more properly call them, "tariffs"). No one will dispute the author's proposition that the object of a tariff system is (1) to secure an income to cover operating and fixed charges and profit; (2) to encourage increased use of electricity for all purposes and by all persons; (3) to avoid discriminations. There is one stated prime object, however, which may or may not be accepted, depending on its interpretation—this is the securing of a "proportional amount of profit from each class of consumer" (though not from each ultimate customer). The author's basis for his tariffs is not cost plus reasonable profit or fair return on fair value but is instead "the value of the service to the consumer which is settled by the price of competitors" (meaning gas or oil, etc.). Fundamentally then the author cannot be in harmony with American rates. This conflict does not extend to the superstructure of rates, as when it is stated: (1) "in calculating charges for a class of new business it is permissible to ignore much of the existing expenditure" with benefit to the original customers due to general decrease in cost of production with the great volume of new business and use of more modern machinery; (2) "it is not necessary that each section of the business should contribute the whole of its share of fixed charges."

The author has a high opinion of the two-part scheme of charging (*a*—a service charge per kilowatt of maximum demand; *b*—an energy charge per kilowatt-hour used) and he has an unique contempt for a single-part scheme. This distrust will not be shared in this country where, by classification of customers and experience with various maximum demands, it has been possible to draw up very simple rate schedules apparently on a one-part scheme but really securing the fair allocation of costs upon a two- or three-part basis.

The author's scrutiny of rate situations has not reached its ultimate stage since he seems to hold that any other utility, like water-supply, must, for equity, make use of a "readiness-to-serve" charge by which fixed charges are distributed according to participation in peak of demand. He neglects the effect of easy storage for such utilities, like water-works, as handle a product and have their investment fixed by total quantity supplied rather than by maximum demand.

A comparison of the union scale of wages and hours of labor prevailing in various cities on May 15, 1912 and 1913, is given in "Wages and Hours of Labor Series," No. 7, recently issued by the U. S. Bureau of Labor Statistics, Washington, D. C. The figures are given not only by trades, but also by classes of workmen under each trade.

ENGINEERING MANUAL OF THE AMERICAN ELECTRIC RAILWAY ENGINEERING ASSOCIATION, Covering Its Standards, Recommendations and Miscellaneous Methods and Practices. New York City: Office of the Secretary, 29 West 39th St. 6x9 in. Loose-leaf form, $3; Cloth binders, $1 extra.

This manual of the American Electric Railway Association is a compilation of accumulated standards and recommendations regarding materials and methods. Practically the whole electric-railway field is covered—buildings and structures, power-distribution lines, poles, rolling stock, signals, track and way, etc. There are 82 sections with innumerable illustrations; "standards" are on blue paper and "recommended practices" are on white. A loose-leaf binding has been used in hope that members may keep the manual up to date.

REINFORCED-CONCRETE RAILWAY STRUCTURES—By J. D. W. Ball, Assoc. M. Inst. C. E. New York: D. Van Nostrand Co. [The Glasgow Text Books, Edited by G. Moncur.] Cloth; 6x9 in.; pp. xiv+208; 127 illustrations. $2.50, net.

This is a British book on which has been placed an American title page. The subject matter is purely British, and applies only in a limited extent to American practice. The author has simplified the formulas for the design of reinforced-concrete members considerably, which is a refreshing novelty in books on reinforced concrete. He evidently recognizes that the peculiarities of construction are so great that extreme refinements in design are not desirable.

Following the usual theoretical chapters, the discussions are on floors, buildings, foundations, retaining-walls, bridges, arch bridges, sleepers (i.e., ties), and fence posts. The chapter on ties is very complete, more nearly so than in any American book.

NEW PUBLICATIONS

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

ACOUSTICS OF AUDITORIUMS—By F. R. Watson, Urbana, Ill.; Engineering Experiment Station, University of Illinois, Bulletin 73. Paper; 6x9 in.; pp. 32; illustrated. 25c.

AUSTRALIAN COMMONWEALTH STATISTICS—Issued by G. H. Knibbs, Commonwealth Statistician, Melbourne, Australia. Bulletin No. 7. Paper; 8x13 in.
Transport and Communication, 1903 to 1913. Pp. 42. Production, 1903 to 1912. Pp. 153.

BETONBAUSTEINE — Herausgeber: Regierungsbaumeister Dr.-Ing. Riepert, Vorstand der Centralstelle zur Förderung der Deutschen Portland-Cement-Industrie. Cement-Verarbeitung Heft 8, 1.-5. Tausend. Charlottenburg, Germany: Cement-verlag G.m.b.H., Knesebeckstr. 74. Paper; 6x9 in.; pp. 44; 41 illustrations. 35 Pfennig.

BRASS-FURNACE PRACTICE IN THE UNITED STATES—By H. W. Gillett, Washington, D. C.; Bureau of Mines. Bulletin 73. Paper; 6x9 in.; pp. 298; illustrated.

CHEMICAL REAGENTS; Their Purity and Tests (Authorized Translation of Prüfung der Chemischen Reagenzien auf Reinheit, Zweite Auflage, von E. Merck)—By Henry Schenck. Second edition. New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. ix + 199. $1, net.
Under an alphabetical arrangement, each of many reagents is listed, its symbol, molecular weight, specific gravity, other characteristics and its uses given; then in most cases various tests for purity are given.

THE CITY MANAGER PLAN OF MUNICIPAL GOVERNMENT—Printed for "The American City," 87 Nassau St., New York, by the National Short Ballot Organization. [Reprinted in part from Beard's Loose-Leaf Digest of Short Ballot Charters. Second edition. Paper; 8x11 in.; pp. 33. 25c.

CRYSTALLOGRAPHY; An Outline of the Geometrical Properties of Crystals—By T. L. Walker, Professor of Mineralogy and Petrography, University of Toronto. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xiv + 204; 233 illustrations. $2, net.

DESIGN AND CONSTRUCTION IN WOOD—By William Noyes, Assistant Professor of Industrial Arts, Teachers College, Columbia University. Peoria, Ill. The Manual Arts Press. Cloth; 6x9 in.; pp. 159; 204 illustrations. $1.50.
Designed to teach boys something about common woods, and particularly how to use carpenters' tools by giving illustrated directions for making a variety of simple objects. Although useful for self-instruction, the book would be of most service under some guidance by an instructor.

FIELD MANUAL FOR PLANE SURVEYING AND RAILROAD CURVES—By R. C. Yeoman, Dean of Engineering, Professor of Civil Engineering, Valparaiso University; City Engineer of Valparaiso, and E. A. Tucker, Instructor in Surveying, Assistant in Civil Engineering, Valparaiso University, Valparaiso, Ind.: M. E. Bogarte Book Co. Cloth; 5x8 in. $2.

FUEL ECONOMY AND CO_2 RECORDERS: A Practical Manual Dealing Chiefly with the Heat Losses in Boilers and the Principle, Operation and Care of CO_2 Recorders—By A. R. Maujer and Charles H. Bromley, of the Editorial Staff of "Power." [Engineers' Study Course from "Power."] Cloth; 6x9 in.; pp. x + 189; 28 illustrations. $1.50, net.

A GLOSSARY OF ROAD TERMS—By H. Percy Boulnois, M. Inst. C. E., Borough Engineer of Portsmouth; City Engineer of Liverpool; Deputy Chief Engineering Inspector of the Local Government Board. London: St. Bride's Press, Ltd. Cloth; 5x8 in.; pp. 71. 2 shillings, net.

ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS—Proceedings of 29th Annual Meeting, Peoria, Ill., Jan. 28-30, 1914. Wheaton, Ill.: E. E. R. Tratman, Secretary. Paper; 6x9 in.; pp. 154; illustrated. 50c.

INVESTIGATIONS ON DRAIN TILE—Report of the Investigations of Committee C-6 on Standard Tests and Specifications for Drain Tile, of the American Society for Testing Materials. Published by authorization of the Society as Bulletin 36, Engineering Experiment Station, Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa. Paper; 6x9 in.; pp. 112; illustrated.

MADRAS PRESIDENCY PUBLIC WORKS DEPARTMENT—Administration Report for 1912-1913. Part II, Irrigation. Madras, India: The Department. Cardboard; 8x13 in.; pp. 271; illustrated.

MAIN DRAINAGE AND SEWAGE DISPOSAL WORKS PROPOSED FOR NEW YORK CITY—Report of the Metropolitan Sewerage Commission of New York, 17 Battery Place, New York City, April 30, 1914. Cloth; 9x12 in.; pp. 762; illustrated.

MATHEMATICS FOR THE PRACTICAL ENGINEER: A Mathematical Manual for the Power Plant Engineer. Contains Simplified Lessons for Home-Study in Fractions, Ratio and Proportion, Percentage, Involution and Evolution, Square Root, Cube Root, Formulas, Logarithms, Mensuration and Plane Trigonometry—By Charles H. Bromley and Henry R. Cobleigh, of the Editorial Staff of "Power." [Engineers' Study Course from Power."] New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. x + 220; 75 text figures. $2, net.

MECHANICAL MOVEMENTS, POWERS AND DEVICES: A Treatise Describing Mechanical Movements and Operative Machinery and the Mechanical Arts, Being Practically a Mechanical Dictionery, Commencing with a Rudimentary Description of the Early Known Mechanical Powers and Defining the Various Motions, Appliances and Inventions Used in the Mechanical Arts to the Present Time; Including a Chapter on Straight Line Movements—By Gardner D. Hiscox, Author of "Gas, Gasoline and Oil Engines," "Compressed Air," etc. 14th Edition, enlarged. New York: The Norman W. Henley Publishing Co. Cloth; 6x9 in.; pp. 409; 1665 text illustrations. $2.50.

NEW JERSEY BOARD OF PUBLIC UTILITY COMMISSIONERS (Trenton, N. J.)—Abstracts of Reports Made by Public Utilities for the Year 1912. Cloth; 6x9 in.; pp. 327.

NEW JERSEY STATE BOARD OF HEALTH (Trenton, N. J.)—37th Annual Report, and Report of the Bureau of Vital Statistics. Cardboard; 6x9 in.; pp. 831; illustrated.

PRACTICAL SANITATION: A Handbook for Health Officers and Practitioners of Medicine—By Fletcher Gardner, Captain Medical Corps, Indiana National Guard; First Lieutenant Medical Reserve Corps, United States Army; Health Commissioner of Monroe Co., Ind., and James Persons Simonds, Professor of Preventive Medicine and Bacteriology, Medical Department, University of Texas; Lately Superintendent Indiana State Laboratory of Hygiene. St. Louis, Mo.: C. V. Mosby Company. Cloth; 6x9 in.; pp. 403; 87 illustrations. $4.

THE ROYAL NAVY; Its Influence in English History and in the Growth of Empire—By John Leyland. New York: G. P. Putnam's Sons. Cambridge, England; University Press. Cloth; 4x7 in.; pp. x + 167. 40c., net.

SANITARY PLUMBING CODE, Clarksburg, W. Va.—Copies sent free on application to Scotland G. Highland, Secretary and General Superintendent, Water-Works and Sewerage Board, Clarksburg, W. Va. Paper; 6x9 in.; pp. 86; illustrated.
Besides giving what appears to be a carefully prepared plumbing code, this handsome pamphlet contains a brief description and a number of illustrations of the Clarksburg water and water purification plants, some useful information for water users and some local climatological matter.

SHOP LIGHTING: A Handbook for Superintendents and Electricians. Madison, Wis.: Industrial Commission of Wisconsin; Secretary, Paul J. Watrous. Paper; 6x9 in.; pp. 52; illustrated.

SURFACE WATER SUPPLY OF THE UNITED STATES, 1912; Part III, Ohio River Basin—By A. H. Horton, W. E. Hall and H. J. Jackson. Washington, D. C.: U. S. Geological Survey. Water-Supply Paper 323. Paper; 9x9 in.; pp. 118; illustrated.